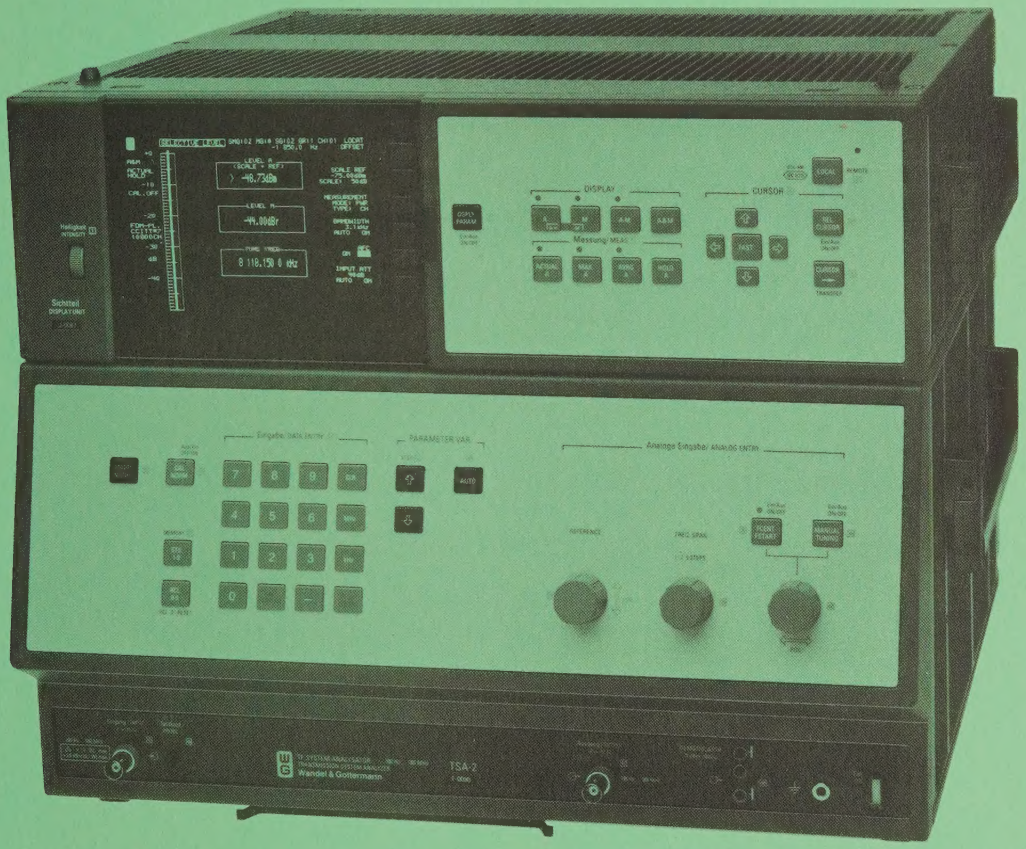
Provisional

Description and Operating Manual



Transmission System Analyzer TSA-2

for frequency range 100 Hz to 180 MHz

BN 0956/00.75

TRANSMISSION SYSTEM ANALYZER TSA-2

for the frequency range 100 Hz to 180 MHz

Provisional Description and
Operating Manual BN 956/04, series F...

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ADDENDUM TO THE TSA-2 DESCRIPTION AND OPERATING MANUAL, BN 956/04

⚠ Remarks

This provisional Operating Manual replaces the former Manual, Edition 3400/7.86.

The Manual of the TSA-2 describes the spectrum analysis operating mode in great detail in Chapter 3. Some chapters have been taken from the Operating Manual for the TSA-1 (BN 956/03) and the SNA-1 (BN 956/01) and so TSA-2 should be read for either TSA-1 or SNA-1 whenever they occur. The TSA-2 also has an enlarged menu and so Figures 2-3 and 3-3 should be replaced by Figures 1 and 2 and the Figure in Chapter 5 "operating mode menu", in the Appendix to Chapter 3.

The Appendix also contains the abridged operating manual for the TSA-2 in which all the operating modes are explained and illustrated.

A SPECIFICATIONS

A.1 SPECTRUM ANALYSIS

- The tracking generator now has the same frequency range as the SNA-1, 100 Hz to 180 MHz. The output level has been increased from -15 dBm to 0 dBm (refers to section 1.1.1.1 footnote, sections 1.3.1.2, 3.3.3.2 and 3.7.1).
- The resolution bandwidth in the modes "Spectrum Analysis" and "Network Analysis" can additionally be switched to 100 kHz and 300 kHz (section 1.1.1.5).
- Amplitude measurements (section 1.1.2.1)
  Calibration, selectable..... dBm, dB, dBµV

Version	dBm (0 dBm ≅ 1 mW)	dB (0 dB ≅ 0.7746 V)	dBµV (0 dBµV ≅ 1 µV)
Z_0 = 75 Ω	0	-9.03	+108.76

- Measurement range
  Z_0 = 75 Ω..... -135 to +20 dBm
- The error limits of the reference level are valid for 30 Hz to 30 kHz resolution bandwidth. For 3 Hz and 10 Hz bandwidth the values given in the table must be increased by 0.5 dB (section 1.1.2.4).
- The option "Adjustable send level" has a setting range from -65 to 0 dBm, adjustable in 0.01 dB steps (section 1.4.2).

A.2 NETWORK ANALYSIS

The following specifications are valid for this measurement mode:

Attenuation/gain

Results given in terms of gain (difference between output level and input level)

Measurement range

	Attenuation	Gain
BN 956/04	0 to 130 dB	0 to 20 dB
with option BN 956/00.04	0 to 130 dB	0 to 80 dB

Display modes

Electronic graticule, vertical axis has 10 divisions.
Gain is equal to the sum of the scale value and the reference value.
Scaling..... 0.1 dB/div. to 10 dB/div. in 1, 2.5, 5 sequences

Reference value

Set via keypad, rotary switch, or by transferring a cursor value
Smallest increment..... 0.01 dB

Calibration/normalisation

The error response of the test setup can be measured and stored, so eliminating the intrinsic error of the Analyzer and the test cables.
The correction curve is stored in internal memory by pressing a button.

Error limits

Error limits of the reference value in the range -50 to +20 dB, for input levels ≥ -50 dBm after normalisation

Scale 1 dB and 2.5 dB	± 0.1 dB	± 0.2 dB
Scale 5 dB ... 50 dB	± 0.25 dB	± 0.35 dB
Scale 100 dB	± 1.2 dB	± 1.2 dB
	100 Hz	110 MHz 180 MHz

Scaling errors including the resolution error of the digital image memory

Error limits (dB)						
0.1 dB/ div.	0.25 dB/ div.	0.5 dB/ div.	1 dB/ div.	2.5 dB/ div.	5 dB/ div.	10 dB/ div.
± 0.05	± 0.06	± 0.20	± 0.30	± 0.40	± 0.50	± 2.0

B GENERAL INFORMATION

B.1 SELFTEST (Section 2.4)

When the TSA-2 is switched on, a selftest is run. The ROM area, the RAM area and the video board are checked.

When the TSA-2 is in operation, a complete selftest can be called up by pressing /MODE MENU/, [30].

When the softkey /SELFTEST/ is pressed an automatic test is run (STATUS: RUNNING). The following subassemblies are checked: ROM, RAM, I/O, CRT, W-BAND-PATH, 5 dB-ATTENUATOR, SIGNAL PATH, SYNTHESIZER, SEL. AMPLIFIER, IF AMPLIFIER.

The test is passed if "OK" is displayed after each subassembly is tested. "TEST FINISHED" appears when the test has been completed. Press /MODE MENU/, [30] to return to the test program.

If the selftest discovers that a subassembly is defective, an error number is displayed (e.g. W-BAND-PATH ERROR NO. 40; the cause of the error may be a missing or defective control cable, consult the service manual), and the test is interrupted.
Display: WAITING FOR COMMAND
This message will also appear when the test is interrupted by pressing the softkey "BREAK".
You can procede in one of the following ways:
- Remove the fault (service manual)
- Repeat the test by pressing the softkey /RESTART/
- Continue the test by pressing the softkey /CONTINUE/
- Return to the test program by pressing /MODE MENU/

Softkey "SERVICE": This key is used to call up information that will be of use when the TSA-2 is being serviced. If you press this key and then /EPROM BVs/ the BV numbers of the EPROMs in the CPU are displayed on the screen. Return to the test program by pressing /MODE MENU/, [30].

MONITOR (service only)

You can enter this menu by calling up the selftest and then pressing /DSPLY PARAM/ [2].
The monitor program has been provided as an aid for servicing the instrument and is designed to help remove faults (see service manual).
You can exit from this menu by pressing /DSPLY PARAM/ or /MODE MENU/.

B.2 STANDARD SETUP

Standard Setup
Some measurement parameters for the standard setup have been slightly changed compared with sections 2.5 and 3.6.5.1.

C OPERATING INSTRUCTIONS

C.1 MARKER FUNCTION in the mode "Spectrum Analysis"

During manual tuning with knob [40], key [36] ON, a marker on curve A shows the actual level value and the measuring frequency (Resolution: 10^{-4} of the frequency span).

C.2 NETWORK ANALYSIS

The operation of the network analysis mode has been modified (cf. section 3.7).

- The tracking generator has an output level of 0 dBm and a frequency range from 100 Hz to 180 MHz.
- With the option BN 956/00.04 the send level can be set in the range -65 to 0 dBm with a resolution of 0.01 dB. Press softkey SEND LEVL and enter the level value via the keypad.
- The reference line (0 dB line) can be shifted vertically within the scale range. Press softkey "SCALE" two times to get ZERO-POS video-inverse, then shift the reference line in steps of one division via the step keys.
- A logarithmic frequency scale can be also selected. Switch-on DSPLY PARAM [2], press softkey FREQ SCALE, select START/DECADE via the step keys. Switch-off DSPLY PARAM and enter the start frequency (2 digits) via the numerical keypad and the number of decades via the step keys.
- The knob [40] for FCENT/FSPAN or MANUAL TUNING is out of function.
- The frequency sweep has been changed from a triangular sweep (section 3.7.4) to a sawtooth sweep. The SNA-1 makes measurements at 500 crystal-accurate frequency points within the selected frequency range.
- A normalising procedure allows you to eliminate the frequency response of the SNA-1, of the cables and test aids. After setting up the test equipment setting all parameters, the normaliser can make very accurate measurements.
  Disconnect the device-under-test and insert a zero attenuation pad. Press /CAL NORM/ [31] to call up the calibration and normalisation menu (see figure a).
  Now softkey 2 can be used to switch the automatic level calibration ON or OFF. Softkey 4 starts the normalisation procedure. Then during one sweep a correction curve is measured and stored internally. As a result, the curve is displayed as a horizontal line with an attenuation of 0 dB. The display "NORM.OFF" at the left screen edge disappears. The softkey 5 allows to clear the normalisation storage and softkey 6 can be used to return into the test menu.

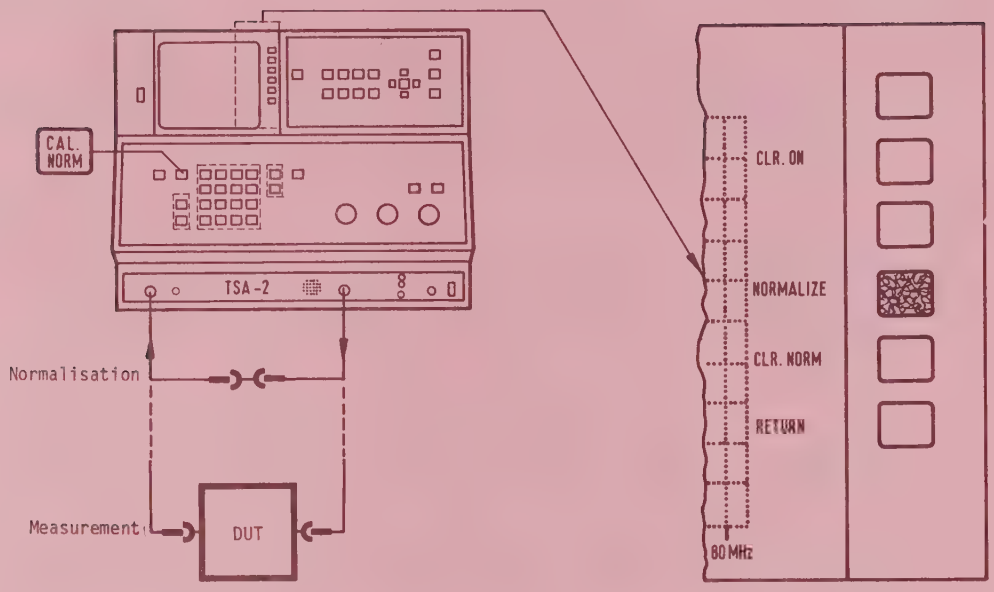

Figure a

Normalisation is possible for input levels not higher than +20 dBm. Furthermore, the attenuation of the test setup must not exceed 65 dB. The permissible frequency response, which can be normalized, is 10 dB within the displayed frequency range.

If important parameters like frequency range or reference are changed, the normalisation is no longer valid (display NORM.OFF). In this case re-normalisation is necessary.

C.3 FURTHER REMARKS

- Correction
  In figure 3-17 the absolute and relative cursor have been changed over by mistake.
- Display intensity
  The potentiometer 92 P 1 on the back panel of the display unit allows you make the brightness of curve A and the background different, this means curve A and curve M can be easily distinguished.

C.4 TONE SEARCH OPERATING MODE

This function initiates an automatic search between two settable frequency limits for signals that exceed a certain level (e.g. hot tones). The speed of the search depends on the selectivity bandwidth that has been selected.

1) TONE SEARCH display and settings

Calling up the operating mode:
* Press /MODE MENU/, [30]

* When you press softkey (6) /NEXT/, "TONE SEARCH" is displayed as one of the menu choices. When you press softkey 2 the appropriate display appears on the screen.

2) Settings and displays

* FSTART/FSTOP
Select the start or stop frequency mode with softkey 1, and enter the frequency using the numeric keypad [32].

* THRESHOLD
After pressing softkey 2 /THRESHOLD/ (inverse video), the threshold can be set using keypad [32]; it can also be set in 5 dB steps with the step keys [3]. One of the following messages may appear on the screen:

LEVEL A < set threshold	The level at the current frequency setting is less than the threshold.
<<THRESHOLD TOO LOW>>	Input signal has caused an overdrive

If the second message has been output, reduce the bandwidth (softkey 3) or increase the level threshold. The level of the signal you are searching for is indicated by an analog and a digital display. The analog scale has a range of 100 dB when the dynamic range of the display is approx. 70 dB (depends on bandwidth) above the level threshold. The reference point for the threshold that has been set is the lower edge of the scale; it is marked "THRESHOLD".

* BANDWIDTH
is set by pressing softkey (3) ("BANDWIDTH" in inverse-video) and then using the step keys [33]; the range is 10 Hz to 48 kHz. The search speed is the best that can be obtained for the bandwidth that has been set. The search speed reaches a maximum at 48 kHz (35 MHz/s) and a minimum at 10 Hz (22 Hz/s).

* MODE
set by pressing softkey 4 ("MODE" inverse-video) and then using the step keys [33]:

SINGLE -->	Single search form fSTART to FSTOP
SINGLE <--	Single search from fSTOP to fSTART
CONTIN	Continuous search between frequency limits. The search starts at fSTART, when a frequency reset is made (softkey 5).

* FREQUENCY RESET
Press softkey 5 /FREQUENCY RESET/; starts the search at fSTART.

* SEARCH RUN/STOP
When all the parameters described above have been set, the search can be started by pressing softkey 6 /SEARCH RUN/. The status display shows "SEARCHING" instead of "NOT SEARCHING". The search can be stopped by pressing softkey 6 once more (/SEARCH STOP/). "NOT SEARCHING" and the last search frequency are displayed on the screen. The search is stopped when any of the other softkeys are pressed. Restart the search by pressing softkey 6. If no signal is found when a single search is being made, the search stops and "SEARCH STOP" and "END OF SEARCH" are displayed on the screen.

Display when a signal is found

"SIGNAL FOUND" is displayed on the screen

The instrument has been exactly tuned to the input signal when "AFC locked" is displayed on the screen. Other messages have the following meanings:

"AFC tracking": The synthesiser is not at present tuned to the input signal; a change in frequency has been made.

"AFC unlocked": A signal has been found. The input signal is not stable, is no longer present at the input, or has left the TSA-1's capture range.

The level of the signal which has been found is shown on an analog and a digital display. If "< threshold" appears on the screen this means that the signal is below the threshold at the current frequency. Switch on the autocal facility for more accurate level measurements.

C.5 DEMODULATION

* Tuning
  - When measurements are to be made on a transmission system that is in use the receiver should be tuned to the suppressed residual carrier.
  - If a discrete frequency, f, is applied to the receiver input, the following settings should be made to translate the frequency to the centre of the band (1,85 kHz).
    "LSB" TSA-1 frequency 1.85 kHz higher than f
    "USB" TSA-1 frequency 1.85 kHz lower than f

* Bandwidth
  - FLAT equal to 3.1 kHz for demodulation or unweighted noise measurements
  - Psophometer filter weighted noise measurements in voice channels.

C.6 AUTOMATIC FREQUENCY CONTROL (AFC)

In the SELECTIVE LEVEL mode, the synthesiser can be tuned to input signals, whose frequencies vary, by means of an AFC circuit. The AFC circuit can be used as a tuning aid if the exact frequency of the input signal is not known (it is best to select the 3.1 kHz bandwidth).

To switch the AFC on or off
* press softkey (6) "AFC ON/OFF"

The capture range of the AFC is equal to the normal bandwidth of the selectivity filter which has been selected.

The AFC status is shown on the "TUNE FREQ" display as follows:

AFC locked: The TSA-1 is tuned to the input signal

AFC unlocked: The TSA-1 is not tuned to the input signal or the input level is too low, or there is no input signal. In the presence of noise or interruptions, the TSA-1 remains tuned to the last set receive frequency.

When the bandwidth is $\leq$ 300 Hz, the display resolution is 0.1 Hz, otherwise it is 1 Hz.

C.7 STORING AND CALLING-UP FIXED FREQUENCIES

Number: 90 fixed frequencies
Address range: 10 to 99

- Storing procedure

Fixed frequencies are stored by means of the following key sequence (switch off AFC):

(softkey 1) F "STO" (softkey 1) address 10 to 99

Entry next frequency F

* Press softkey (1) "FREQ" - Display: "FREQ" inverse video
* Enter the frequency via the keyboard
* Press key [37] "STO"
* Press softkey (1) "FREQ" - Display: "MEM-FRQ" inverse video
* Select storage location (address 10...99) via keyboard
- Display: "FREQ" inverse video
* Enter next frequency etc.

- Call-up procedure

Fixed frequencies are called up by means of the following key sequence:

"RCL" (softkey 1) address 10 to 99 → next address
→ STEP [33] ⇧ ⇩

* Press "RCL" [37]
* Press softkey (1) "FREQ" - Display: "MEM-FRQ" inverse video
* Select address (10 to 99) via keyboard.
The TSA-1 is immediately set to the required fixed frequency
The appropriate address is displayed ("MEM-FRQ").

As the "MEM-FRQ" function stays on (softkey 1), the up/down keys can be used to call up the fixed frequencies in consecutive order. The addresses are stepped through in cyclic order i.e. 98, 99, 10... or 11, 10, 99...
It is possible to switch off the MEMORY function by pressing softkey 1 "MEM-FRQ".

D ACCESSORY

D.1 SNZ-1 STANDARD FREQUENCY ADAPTOR

The SNZ-1 is a small auxiliary device that converts a standard frequency between 0.3 and 9.9 MHz to a frequency of 1 MHz. The input frequency is first of all divided to give a frequency of 100 kHz. The division factor can be set using two small rotary switches. The frequency is then multiplied using a high Q resonant circuit tuned to 1 MHz.

TECHNICAL DATA

Frequency	
Input frequency, adjustable	0.3; 0.4; 0.5; ...; 9.9 MHz
Max. deviation from set value	± 0.1%
Output frequency	1 MHz
Inputs and outputs*)	
Input/output impedance	75 Ω
Input level	-10 to +10 dBm
Output level	approx. 0 dBm
Harmonic ratio a_{k2}, a_{k3}	approx. 20 dB
General data	
Power supply	from external power unit
Connector	jack socket, two-pole; 2.5 mm
Voltage	+12 to +15 V
Current taken	approx. 50 mA
Dimensions (W x H x D in mm)	126 x 36 x 64

Ordering information

Standard frequency adaptor SNZ-1	BN 956/00.07
Accessories (charged extra)	
Power supply/charger	
with Standard European power plug (193 to 242 V; 47,5 to 63 Hz)	BN 964/00.02
with U.S. type power plug (105 to 132 V; 47.5 to 63 Hz)	BN 964/00.03
with U.K. type power plug (211 to 264 V; 47.5 to 63 Hz)	BN 964/00.04

CONNECTING UP AND SETTING THE SNZ-1

* Connect power unit. If you are using a power unit from another company please note that the minus pole is connected to the housing of W&G instruments. A diode prevents damage if polarity is reversed.
* SNZ-1's input connector (next to power connector) should be connected to the standard frequency connector using a length of coaxial cable.
* Set both switches to the standard frequency:
  - The first switch from the left is used to set units (0 to 9 MHz),
  - the second switch from the left is used to set tenths (0.1 to 0.9 MHz).

  The standard frequency connected to the input must not vary by more than ± 0.1% of the set value.
* Connect the SNZ-1's output to the TSA-1's standard frequency input

*) The 75 Ω connectors can be replaced by other Versacon® 9 inserts.

E ABBREVIATED OPERATING MANUAL

E.1 MODIFICATIONS to the points in the Appendix

To 3. Tracking-generator: output level 0 dBm; frequency range 100 Hz to 180 MHz.

To 5. Mode menu; slight modification of the mode arrangements. The mode TONE SEARCH is available. An additional mode is the NETWORK ANALYSIS (see Figure 1 and 2).

To 6. Additional measuring parameters

VDU screen	Parameter (softkey function)	Set-up with	
NETWORK ANALYSIS FSTART DECADE	Starting frequency, fSTART 1)	[32]	2 digits resolution
	Number of decades, DECADE for logarithmic frequency axis	[33]	from 1 to max. 8 decades
REFERENCE -25.00 dB	REFERENCE gain 1) (0 dB reference trace)	[32] [33] [38]	0.01 dB resolution } 1 graticule division/ step
SCALE 100 dB ZERO-POS	Display range (10 divisions of vertical axis) Vertical position of 0 dB trace	[33] [33]	1-2.5-5 steps from 1 to 100 dB 1 graticule division/step
SEND LEVL 0 dBm	Output level of tracking generator	[32]	Fixed level or settable from -65.00 to 0.00 dBm, 0.01 dB resolution (option)
TONE SEARCH FSTART FSTOP	Starting frequency, FSTART 1)	[32]	0.1 Hz resolution
	Stopping frequency, FSTOP 1)	[32]	0.1 Hz resolution
THRESHOLD +0.00 dBm	Level threshold for signals to be found	[32] [33]	0.01 dB resolution in 5 dB steps
MODE SINGLE ->	Sweep mode for searching	[33]	SINGLE from FSTART to FSTOP (->) or reverse (<-) or CONTINuous
FREQUENCY RESET	Reset to the beginning frequency for searching	-	switching by softkey
SEARCH RUN [STOP]	Run or stop of the searching sweep	-	switching by softkey

1) Setting also possible through Cursor Transfer (see 9.3)

To 6.4 Additional display parameters for level measurements:
- Level M (entry by storage A -> M or via keypad [32] with 0.01 dB resolution)
- Send level (fixed level or settable via keypad [32] from -65 to 0 dBm, optional).

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APPENDIX TO CHAPTER 3

INTRODUCTION

The TSA-2 Transmission System Analyzer (BN 956/04) is well-suited for a wide range of selective frequency measuring tasks in the 100 Hz to 180 MHz range.

Because of its precise synthesiser tuning the TSA-2 is ideal for carrying out spectrum analysis on wanted and noise signals that are encountered in telecommunications and telecontrol work, for example, analog and digital telecommunications systems with cable, radio-relay or satellite sections up to the 140 MHz IF level. Because the frequency tuning has a high resolution of 0.1 Hz, and a high bandwidth resolution of 3 Hz is available, dense line spectra can be analysed, e.g. in the audio frequency range, or the sideband noise of oscillators near the carrier.

Selective and wideband measurements can also be made. The level is shown digitally or as a bar-chart on the screen. Special filters have been provided for weighted and unweighted noise measurements on CF-voice channels.

The built-in demodulator is used to demodulate inverted or erect single-sideband signals. The demodulated signal can then either be output for qualitative assessment to a loudspeaker, or is output at the demodulator output for further processing. Phase jitter measurements to determine the quality of telephone lines used for data transmission can also be carried out. As with the other level measurement modes, the results are shown by means of a digital display or by means of a quasi-analog bar-chart.

The variation of gain or loss with frequency introduced by transmission systems, or system components such as filters, amplifiers, audio and video subassemblies are easily measured with the integral tracking generator.

The most important basic characteristics of the TSA-2 are its high accuracy of measurement and its foolproof ease of operation.

The precise synthesiser tuning and the automatic amplitude calibration are the main factors contributing to the accuracy of the TSA-2. The TSA-2's large, flat screen with an electronically scaled internal graticule makes it possible to precisely evaluate measurement curves. Parallax reading errors are, therefore, also eliminated. Frequency and level cursors are provided to simplify reading trace values. An alphanumeric display superimposed on the screen shows the values indicated by the cursors. Because of two digital trace memories, a measurement trace and a reference trace can be displayed simultaneoulsy; the difference trace can also be shown. The last mentioned operating mode allows the user to determine exceedingly small variations from a given nominal value.

To ensure maximum ease of operation, the number of control elements has been kept to a minimum using softkeys. The TSA-2 software assigns each softkey a function depending on the measurement to be performed. The function of the softkey is shown on the screen next to the softkey. Six softkeys are sufficient to select the measurement mode (including self-test), the measurement parameters and the display format.

It is easy to incorporate the TSA-2 into measuring systems as all its functions can be remote-controlled via the standard IEEE 488/<IEC 625> interface bus. The TSA-2 can therefore be used for system monitoring and production testing, areas where economical measuring procedures are essential.

1 SPECIFICATIONS

1.1 SPECTRUM ANALYSIS

1.1.1 FREQUENCY

1.1.1.1 Measurement range ..... 100 Hz[1] to 180 MHz

1.1.1.2 Display scale

Electronic internal graticule; scaling of the horizontal axis takes the frequency span into account. Scaling can be switched over to the start/stop frequency, centre frequency/frequency span or start frequency/frequency span.

Start and stop frequency or centre frequency

Entry via keypad. The centre frequency and the start frequency can be adjusted quasi-continuously with a knob, or by transferring a cursor value.

Setting range ..... 0 Hz to 180 MHz

Resolution,
- keypad ..... 0.1 Hz
- knob or cursor transfer ..... 2×10^{-3} x f.span

Frequency span

Via keypad or in steps via rotary switch or increment buttons.

Setting range ..... 0 Hz to 180 MHz

Resolution,
- keypad ..... 0.1 Hz
- Rotary switch, increment buttons ..... 100 Hz to 180 MHz in 1, 2, 5 sequence

1.1.1.3 Measuring frequency

Linear sweep between start and stop frequency, also manual tuning via knob.

Resolution,
- sweep mode ..... $\geq$ 0.1 Hz
- manual tuning ..... 10^{-4} x f.span

1.1.1.4 Error limits

of the start, stop and measuring frequency including ageing for 1 year ..... $\pm 3 \times 10^{-7}$
with the BN 865/00.03 option ..... $\pm 1 \times 10^{-7}$

1) Series A to C: When the tracking generator is used, the frequency range is restricted and ranges from 10 kHz to 180 MHz

1.1.1.5 Resolution bandwidth

Switchable selective filters with approximately Gaussian transfer function.
Filter selection takes place automatically when the frequency span is set, or is initiated manually via the increment buttons.

3 dB bandwidth ..... 3 Hz to 30 kHz in 1, 3, 10 sequence
Error limits ..... ±20%
60 dB:3 dB bandwidth ratio ..... ≤ 11:1

1.1.2 AMPLITUDE

1.1.2.1 Measurement ranges

Power level referred to 1 mW ..... -130 to +20 dBm
Voltage level referred to 0.7746 V ..... -140 to +10 dB

1.1.2.2 Display range

Electronic graticule, vertical axis has 10 divisions. The reference value is indicated by the top grid-line.

Scaling ..... 0.1 to 10 dB/div. adjustable in 1, 2.5, 5 sequence

Reference value

Entry via keypad, rotary switch, increment buttons or by transferring a cursor value
Setting range ..... -130 to +20 dBm/-140 to +10 dB
Smallest increment ..... 0.01 dB

1.1.2.3 Automatic calibration (can be switched off)

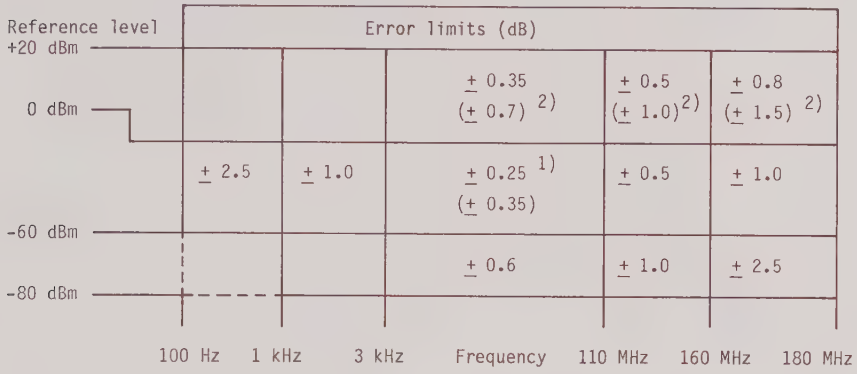
carried out at the centre frequency after each change of parameter that could affect the amplitude accuracy, and at fixed intervals.

1.1.2.4 Error limits

If nothing to the contrary is stated, the error limits for the nominal ranges of use of the influence quantities given in 1.3.4, with the automatic calibration switched on, (source has an output impedance $Z_{out} = Z_0$) apply.

Error limits of the reference level

at the centre frequency, taking discrete internal spurious signals into account (see 1.1.3.3) and at an input attenuation ≥ 10 dB.



Scaling errors

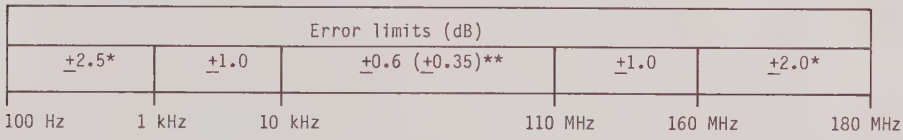
when the input attenuator is set automatically, including resolution errors of the digital image store

Error limits (dB)						
0.1 dB/ div.	0.25 dB/ div.	0.5 dB/ div.	1 dB/ div.	2.5 dB/ div.	5 dB/ div.	10 dB/ div.*
±0.05	±0.06	±0.20	±0.30	±0.40	±0.50	±1.0 (±1.5)

* The values without brackets refer to scale range +10 to -60 dB, those with brackets to the range +10 to -80 dB.

Frequency response

from -70 to 0 dBm (-80 to -10 dB) referred to the centre frequency



* Typical value ±1.5 dB

** The value in brackets is valid for frequency spans ≤ 30 MHz and a restricted ambient temperature between +20 and +26 °C

1.1.3 INTRINSIC SPURIOUS SIGNALS AND INTRINSIC NOISE (DYNAMIC RANGE)

1.1.3.1 Spurious signals

When an input signal is present, the reference level is ≤ +10 dBm (0 dB) and the input attenuator is set automatically (resolution bandwidth ≤ 1 kHz).

Intrinsic harmonic ratio a_{k2} and a_{k3} when loaded with a single tone ≤ ref. level ..... ≥ 70 dB

Intermodulation products of the 2nd and 3rd order ≥ ... 70 dB
below the greater of two signals,
each ≥ 6 dB below the reference level

Attenuation of nonharmonic spurious signals ..... ≥ 70 dB

Image frequency and IF-suppression (IF = 220 MHz, 40 MHz, 4 MHz, 400 kHz)
at 110 MHz and 220 MHz ..... ≥ 55 dB
at 400 kHz, 4 MHz and 40 MHz ..... ≥ 70 dB
at tuning frequencies ±2 x IF ..... ≥ 70 dB

1.1.3.2 Spurious signals when no input signal is present

Input terminated with Z_o, input attenuation 0 dB

Discrete spurious signals f ≥ 300 kHz ..... ≤ -130 dBm (-140 dB)
f ≥ 100 Hz ..... ≤ -115 dBm (-125 dB)

Intrinsic noise level

Resolution bandwidth	Limits of the intrinsic noise level (dBm) (dB = dBm - 10)			
30 kHz				-105
10 kHz				-115
3 kHz			-100	-120
1 kHz			-105	-125
300 Hz			-110	-125
100 Hz		-100	-115	-130
30 Hz		-105	-120	-135
10 Hz	-110		-125	-135
3 Hz	-115		-130	-135

100 Hz 3 30 300 kHz 180 MHz

1.1.4 SWEEP, VIDEO FILTER

1.1.4.1 Sweep

Sweep shape ..... saw-tooth, single sweep facility with remote control option

sweep druation ..... 200 ms, 500 ms, 1s, 2s, 5s, ..., 20 h

Automatically set with the frequency span and resolution bandwidth, or manually via increment keys.

1.1.4.2 Video filters

for noise averaging, automatic filter selection in conjunction with resolution bandwidth, or manual filter selection via increment buttons.

Video bandwidth ..... 5 Hz to 150 kHz in 5, 15 sequence

1.2 LEVEL MEASUREMENTS

1.2.1 FREQUENCY

1.2.1.1 Frequency range

for selective and wideband measurements ..... 1 kHz to 180 MHz

1.2.1.2 Frequency display ..... 10-digit display field on screen

Resolution ..... 0.1 Hz

1.2.1.3 Frequency setting

Digital setting via keyboard
in increments by means of special keys, increment size is entered via the keyboard
Knob for quasi-continuous tuning over the whole range, coarse and fine tuning

Smallest increment, digital ..... 0.1 Hz
quasi-continuous, fine ..... 1 Hz
coarse ..... 100 Hz

1.2.1.4 Automatic frequency runs (in preparation)

Tone search

Over the whole frequency range, fine tuning to located signal by means of automatic frequency control (AFC).
The correct search speed is automatically selected for the bandwidth chosen:

Bandwidth	48 kHz	3.1 kHz	300 Hz	30 Hz	10 Hz
Search speed	35 MHz/s	850 kHz/s	15 kHz/s	150 Hz/s	22 Hz/s

Auto step

The tuning frequency is incremented automatically between adjustable limits.
The increment and limits are entered via the keyboard.

Adjustable step speed ..... 0.2 s, 0.5 s, 1 s, 2 s, 5 s to 20 h

Tracking receiver

Fast AFC tunes the receiver to the swept send signal.

1.2.1.5 Automatic frequency control

The capture range is equal to the nominal bandwidth of the selectivity filter (see 1.2.4) used by the instrument

The holding range is equal to the frequency range given in 1.2.1.1

1.2.1.6 Error limits

of the tuning frequency including 1 year's ageing ..... $\pm 3 \times 10^{-7}$
with option BN 865/00.03 ..... $\pm 1 \times 10^{-7}$

1.2.2 LEVEL

1.2.2.1 Measurement ranges

Input	Selective operating mode		Wideband operating mode	
	dBm[1]	dB[2]	dBm[1]	dB[2]
Coax. 75 Ω	-130 to +20	-140 to +10	-50 to +20	-60 to +10

1) Power level referred to 1 mW
2) Voltage level referred to 0.7746 V

1.2.2.2 Result display ..... digital, in selective mode also analog display

Digital ..... 5 digit field on screen
Analog ..... quasi-analog bar-chart on the screen with selectable scales
Scale ranges ..... 1 dB, 2.5 dB, 5 dB to 100 dB

Setting the 0 dB scale value (reference) manually via the numerical keypad, via the step keys, or automatically
maximum resolution ..... 0.01 dB
Resolution of the digital display ..... 4×10^{-3} of the scale range
Detector characteristic, switchable ..... average value (fast) or rms

1.2.2.3 Level calibration (can be switched off)

Automatic level calibration is carried out at fixed intervals, and whenever a parameter that may affect the accuracy of the level display is changed. In the selective operating mode, the frequency of the calibration signal tracks that of the receiver. In the wideband operating mode there is a fixed calibration frequency of 10 MHz.

1.2.2.4 Level display errors

Unless otherwise stated, the error limits for the nominal ranges of use for the influence quantities (automatic calibration on) listed in 1.3.4 apply. A source with an output impedance

of Z_0 is used. For this reason, level errors that are caused by the reflections at the input impedance are taken into account.

Selective operating mode errors

Error limits of the digital display, including scale resolution errors for the 1 dB and 2.5 dB scales, and also the intrinsic noise as described in 1.2.3.

(Table values from 60 kHz apply to the 48 kHz bandwidth)

Level	Error limits/dB			
+20 dBm (+10 dB)	± 1	± 0.5	± 1.0	± 1.5
0 dBm (-10 dB)	± 0.5	± 0.25	± 0.5	± 1.0
-60 dBm (-10 dB)	± 1	± 0.6	± 1.0	± 2.5
-90 dBm (-100 dB)				
	1 kHz	10 kHz	100 MHz	160 MHz 180 MHz

In the ranges 5 dB to 100 dB the values given in the Table are increased by the rounding error as a result of the decreased resolution described in 1.2.2.2.

Wideband operating mode errors

in the level range -50 dBm to +20 dBm (-60 dB to +10 dB)

± 1 dB	± 2 dB	± 2.5 dB
6 kHz	110 MHz	160 MHz 180 MHz

1.2.3 INTRINSIC NOISE

1.2.3.1 Intrinsic noise level

(maximum values) when the test input is terminated with Z_0 = 75 Ω

Bandwidth	Intrinsic noise level/dBm (dB)			
48 kHz				-105
3.1 kHz			-100	-120
300 Hz			-110	-125
30 Hz		-105	-120	-135
10 Hz	-100		-125	-135
	100 Hz	3 kHz	30 kHz	300 kHz 180 MHz

1.2.3.2 Discrete spurious signals

f ≥ 300 kHz ..... ≤ -130 dBm (≤ -140 dB)
f ≥ 6 kHz ..... ≤ -115 dBm (≤ -125 dB)

1.2.3.3 Image frequency- and IF suppression

(IFs of 220 MHz, 40 MHz, 4 MHz and 400 kHz)
at 110 MHz (half 1st ZF) and 220 MHz ..... ≥ 55 dB
at 40 MHz, 4 MHz, 400 kHz ..... ≥ 70 dB
at tuning frequency + 440 MHz ..... ≥ 70 dB

1.2.3.4 Intrinsic harmonic ratio a_{k2} and a_{k3} ..... ≥ 70 dB

loaded with a fundamental having a level ≤ +10 dBm (0 dB) and with 40 dB more sensitivity than for the measurement range of the fundamental level.

1.2.3.5 Attenuation of nonharmonic spurious signals ..... ≥ 70 dB

1.2.3.6 Noise power ratio ..... approx. ≥ 50 dB

loaded with noise having a bandwidth 4 to 60 MHz,
wideband level -25 to +10 dBm, bandwidth 3.1 kHz

1.2.4 SELECTIVITY

Bandwidth		Frequency deviation about the centre frequency for an attenuation of			
3 dB	Effective[1)]	≤ 1 dB	≥ 25 dB	≥ 45 dB	≥ 60 dB
10 Hz					± 70 Hz
30 Hz					± 200 Hz
300 Hz					± 2 kHz
	3.1 kHz			± 2 kHz	± 15 kHz
	48 kHz	± 20 kHz	± 48 kHz		

1) Effective noise bandwidth

1.2.5 PHASE JITTER

The weighting filters and detector used for measuring phase jitter with CCITT O.91

1.2.5.1 Measurement range

Display range (peak-to-peak) ..... 0.3 to 30°
Measurement result display ..... 3 digits
display field on screen
also with quasi-analog bar-chart
Resolution of the digital display ..... 0.1°

1.2.5.2 Weighting filters

switchable ..... 4 Hz to 20 Hz
4 Hz to 300 Hz
20 Hz to 300 Hz

1.2.5.3 Error limits of the digital display

for signal $\geq$ -60 dBm (-70 dB) at a jitter frequency of 150 Hz (10 Hz for 4 Hz to 20 Hz weighting)

Weighting filters 20 Hz to 300 Hz ..... $\pm$10% $\pm$0.5°
4 Hz to 300 Hz ..... $\pm$10% $\pm$0.7°
4 Hz to 20 Hz ..... $\pm$10% $\pm$0.7°

1.2.6 DEMODULATION

Single-sideband demodulation, switchable to erect or inverted position for weighted and unweighted noise measurements.

Built-in loudspeaker with volume control.

1.2.6.1 Frequency of the converted channel when tuned to the carrier ..... 300 Hz to 3.4 kHz

1.2.6.2 Measurement range for noise measurements ..... 0 to -65 dBm0

Noise weighting, switchable ..... flat, weighted
Weighting filter, standard ..... psophometer filter as per P.53

1.2.6.3 Result display ..... digital with analog display

Error limits of the digital display, measured with an 800 Hz test tone[1] ..... $\pm$0.5 dB

1.2.6.4 Test output, connector ..... 3-pole CF connector

Output impedance ..... 600 Ω
Output level proportional to analog display,
level at 0 dB display, Z_L = 600 Ω ..... approx. 0 dBm

1) Baseband: 6 kHz to 110 MHz

1.3 GENERAL SPECIFICATIONS

1.3.1 TEST CONNECTIONS

Coaxial* ..... Versacon® 9 Universal Connector System
Compatible with all common connector types

System impedance ..... 75 Ω

1.3.1.1 Input

Input impedance ..... 75 Ω

Return loss when the input attenuator is set to values ≥ 10 dB
- f ≤ 110 MHz ..... ≥ 26 dB
- f ≤ 180 MHz ..... ≥ 20 dB

Max. continuous input power ..... 100 mW
Max. peak input-voltage ..... 20 V

High-impedance measurements with the TK-11 Active Test Probe.

1.3.1.2 Tracking-generator output

tracks the frequency of the Analyzer ..... 10 kHz to 180 MHz
Level range, Version BN 956/01 ..... -15 dBm, fixed
Output impedance ..... 75 Ω

Level error limits, $Z_{out} = Z_o$ ..... ±1.0 dB
Return loss ..... ≥ 20 dB

1.3.2 OTHER INPUTS AND OUTPUTS

1.3.2.1 Input* for external standard frequency

Frequency ..... 1, 2, 5, or 10 MHz
Level ..... -10 to +10 dBm
Input impedance ..... 75 Ω

1.3.2.2 Output* for internal standard frequency

Frequency ..... 10 MHz
Level into 75 Ω, nominal value ..... 0 dBm

---

* Equipped with the 75 Ω basic connector Versacon® 9 and BNC adapter. For other adapter types, see "Specification Sheet Versacon® 9", and order chosen type when ordering instrument.

1.3.2.3 Input and output for the control freqency

for controlling the analyser unit by the synthesiser
Frequency range ..... 220 to 400 MHz
Level into 75 Ω, nominal value ..... +3 dBm

1.3.2.4 IF* output

IF frequency ..... 400 kHz
Output level when the reference level is displayed, at a load impedance >> 75 Ω .. -10 dBm ±5 dB

1.3.2.5 Video output (BNC)

for external monitor or video plotter
Output voltage, 75 Ω termination ..... V_{p-p} = 1 V
Frame frequency ..... 50 Hz
Line frequency ..... 15.6 kHz
Compatible with CCIR television standards.

1.3.2.6 Power supply connection for the TK-11 Test Probe

Short-circuit proof, automatic compensation for the insertion loss of the probe (10 dB)

1.3.2.7 Remote control input (only with option BN 958/21)

for controlling all device functions
with the exception of brightness.
Interface functions ..... SH1, AH1, T6, L4, SR1, RL1, PP2, DC1, DT1, CØ

1.3.3 DISPLAY UNIT

CRT with digital image storage
CRT ..... 7" flat screen
Adjustable brightness

1.3.3.1 Result display

Spectrum analysis ..... 2 digital trace stores
X resolution ..... 500 pixels
Y resolution ..... 256 pixels
Screen format ..... test and reference curves can be shown individually, together, or as a difference

* Equipped with the 75 Ω basic connector Versacon®9 and BNC adapter. For other adapter types, see "Specification Sheet Versacon®9", and order chosen type when ordering instrument.

Level measurements ..... 4 display fields for frequency and level, also quasi-analog bar-chart
Resolution of bar-chart display ..... 256 pixels
Trace display ..... actual measurement trace and stored trace separately, together or as a difference

1.3.3.2 Cursor format

(switched off during level measurements)

Frequency cursor resolution ..... 500 pixels
Level cursor resolution ..... 256 pixels

Frequency and level values are shown alphanumerically on the screen.
The resolution is as follows
Frequency ..... 2×10^{-3} x f.span $\pm$0.1 Hz
Level ..... 4×10^{-3} x level range $\pm$0.01 dB

1.3.3.3 Background display

Electronically controlled and scaled graticule. All important parameters are shown alphanumerically. User programmable tolerance masks.

1.3.3.4 Other functions

- Digital noise averaging to reduce the fluctuation of noisy signals
- Max hold function shows the largest level measured at any frequency
- Memory for device setups and tolerance masks

1.3.4 POWER SUPPLY ENVIRONMENTAL CONDITIONS AND NOMINAL RANGES OF USE

The error limits given previously in the specifications are valid for the following nominal ranges of the influence quantities stated, unless otherwise noted.

1.3.4.1 Power supply

Nominal range of use ..... 110/117/127/220/227/237 V, -12 to +10%
Nominal range of use for a.c. line frequency ..... 47.5 to 63 Hz
Power consumption, analyser unit ..... 100 VA
display unit ..... 80 VA
Safety Class to IEC 348 ..... Class I
Maximum warm-up time
(if the instrument is already at room temperature when it is switched on) ..... 15 min

1.3.4.2 Ambient temperatures

Nominal range of use ..... +5 to +40°C
Storage and transportation range ..... -40 to +70°C
RFI/EMI suppression ..... to Bundespost Vfg. 526/1979

1.3.4.3 Data retention

Built-in trickle charged NiCad battery for maintaining memory contents, i.e. for the device setups, the reference trace and the tolerance masks, when the a.c. mains fails.

1.3.5 DIMENSIONS OF THE BENCH MODEL (w x h x d) in mm

Analyser unit ..... 479 x 240 x 452
Display unit ..... 479 x 137 x 414
19" conversion kit available on request.

Weight
Analyser unit ..... approx. 24 kg
Display unit ..... approx. 14 kg

1.4 O P T I O N S

1.4.1 HIGHER FREQUENCY ACCURACY, BN 865/00.03 ..... $\pm 1 \times 10^{-7}$

1.4.2 ADJUSTABLE SEND LEVEL, BN 956/00.04

Frequency range ..... 100 Hz to 180 MHz
Send level ..... -64 to 0 dBm, adjustable in 0.1 dB steps

1.4.3 <IEC> INTERFACE BUS BOARD, BN 958/21

for controlling the TSA-2 via an external computer

1.5 ACCESSORIES

1.5.1 TK-11 TEST PROBE (active) BN 573/00

Frequency range ..... 2 kHz to 160 MHz

Attenuation, termination $Z_{in} = Z_{out} = 75\ \Omega$
at 100 kHz, +20°C ..... 10 dB ±0.1 dB

Frequency response, referred to 100 kHz
$f \leq 100$ MHz ..... $\leq$ 0.2 dB
$f \leq 160$ MHz ..... approx. 0.2 dB

Input impedance
$f \leq 25$ MHz ..... approx. 50 kΩ ||3.5 pF*
$f \leq 100$ MHz ..... approx. 5 kΩ ||3.5 pF*
$f \leq 160$ MHz ..... approx. 2 kΩ ||3.5 pF*

* All capacitances apply to TK-11 with test prod

1.6 ORDERING INFORMATION

Transmission System Analyzer TSA-2* BN 956/04

Options (charged extra)
Higher frequency accuracy[1] ..... BN 865/00.03
Adjustable send level [1] ..... BN 956/00.04

<IEC 625> interface bus board ..... BN 958/21
with IEEE 488 connector

Accessories (charged extra)
Test Probe TK-11[2] ..... BN 573/00
Matching Section FEDA-1 75 Ω/50 Ω ..... BN 319/00
Connecting cables for <IEC 625> interface bus
120 cm ..... K 343
200 cm ..... K 344
Front and Back Panel covers (1 set)
for the analyser unit, SD-50 ..... BN 700/00.28
for the display unit, SD-30 ..... BN 700/00.27

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* Equipped with the 75 Ω basic connector Versacon® 9 and BNC adapter. For other adapter types, see "Specification Sheet Versacon® 9", and order chosen type when ordering instrument.

1) Order with the mainframe

2) See the spec. sheet "Measuring Accessories" for further data and extra ordering information

2 GENERAL INFORMATION FOR THE USER

2.1 SETTING UP THE SNA-1 FOR OPERATION

2.1.1 UNPACKING THE SNA-1

The display unit and the analyser unit of the SNA-1 are delivered in a special container which has been designed to withstand severe stresses in transit. Various connecting cables and the mains cable for the SNA-1 are also contained in this container.

The units can be removed from their containers by pulling on the plastic coverings. The foam protection can then be removed. It is advisable to keep the packaging should you want to ship the SNA-1 at a later date.

2.1.2 JOINING THE SNA-1 SUBUNITS TOGETHER (FAST LOCKING MECHANISM)

There are four fast-locking mechanisms to join the two SNA-1 units together. The locking-tongues are fitted to the top of the analyser unit (see Figure 2-1a). Slots to accommodate the locking-tongues are to be found on the bottom of the display unit.

* Set the analyser unit on a firm surface
* Set the locking-tongues (slot) to the "open" position, see Figure 2-1a
* Set the display unit on the analyser unit
* Set the locking-tongues to the "closed" position, see markings shown in Figure 2-1b.

The display unit must always be placed on top of the analyser unit. Any other arrangement prevents the proper circulation of air between the units (cf 2.1.3).

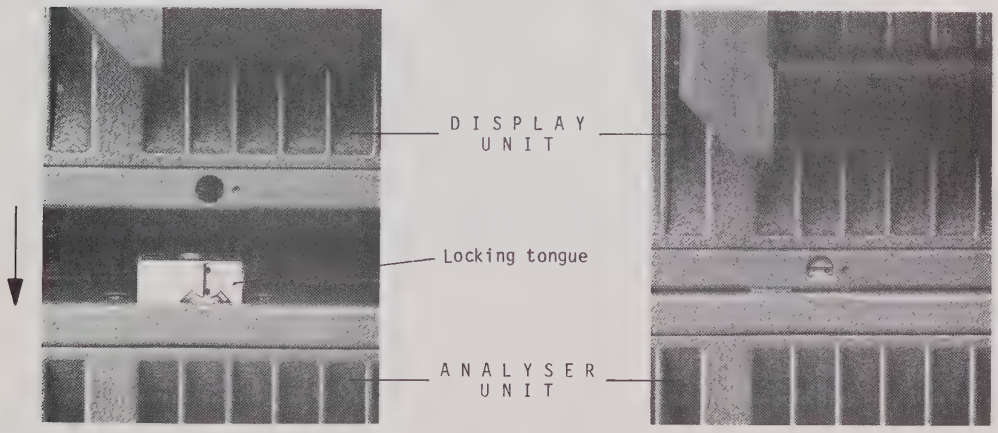


Figure 2-1 Fast-locking mechanism for the analyser and display units

▌When the SNA-1 is carried by its side-handles, all four locking-mechanisms must be closed.

2.1.3 COOLING FAN

The SNA-1 can be operated at ambient temperatures between +5 and +40°C. The SNA-1 has a fan so that it can be operated at high temperatures over long periods without breaking down.

The quiet, efficient fan is mounted on the back panel of the SNA-1 and circulates air through both units. There are slots in the bottom of the display unit and in the top and bottom of the analyser unit for this purpose. The air below the analyser unit is sucked up and passed through both units.

For this reason, there must always be a space between the bottom of the SNA-1 and the surface on which it stands.

2.1.4 POWER SUPPLY AND BACK-PANEL CABLING

The analyser unit and the display unit both have separate power supplies. Before connecting the SNA-1 to the mains (47.5 to 63 Hz), check that the mains voltage selector switch [M] on the display unit is set to the correct position and that the correct fuses have been fitted (see Figure 3-2). It is not necessary to set the mains voltage on the analyser unit as it is powered by a switching power supply and can be operated between 96 and 261 V without changing the setting.

	Mains voltage	Fuse
Display unit	220, 227, 235 V 110, 117, 127 V	T 0.63 A (slow) T 1.25 A (slow)
Analyser unit	96 to 261 V	T 3.15 A (slow)

Use the supplied cable to connect the analyser unit to the mains (mains plug, see Figure 2-2). In accordance with VDE 0411, the SNA-1 is in Safety Class I, i.e. the casing and earth socket are both connected to the protective conductor. If another type of mains cable is used, make sure that it has a protective connector. A cable from the analyser unit is used to supply a.c. power to the display unit.

Several cables are used to exchange signals between the display unit and the analyser unit. Figure 2-2 shows you how to connect up these cables. The cables are delivered with the SNA-1.

Signal	Connector designation on the display unit	analyser unit	Cable designation
● Data and address bus	[55] ⟺	[50]	K 416
● 400 kHz IF	[54] →	[61]	K 197 (BNC)
	[53] ←	[60]	K 197 (BNC)
● Carrier frequency 220 to 400 MHz		[58] ↓ [52]	K 336 (BNC)

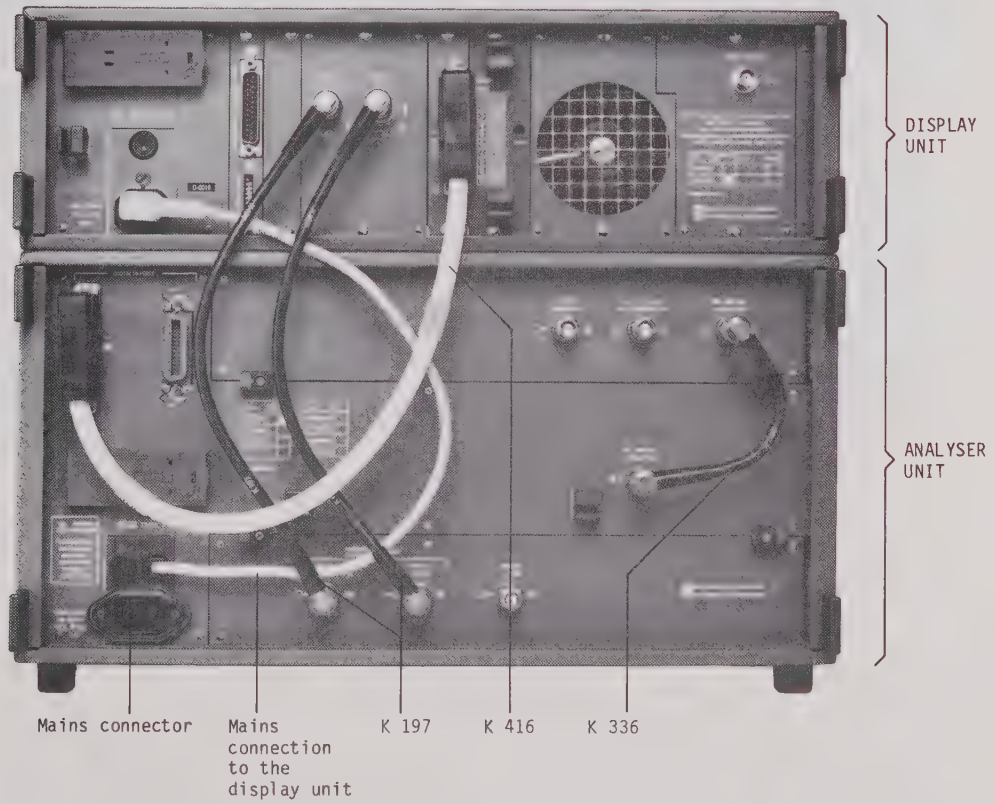


Figure 2-2 Cable connections on the back panel of the SNA-1

2.2 SWITCHING ON THE SNA-1

Use button F to switch on the SNA-1 (see Figure 3-1). An automatic RAM/ROM test is then carried out to check the read-write memory and the operating software (ROM). All LEDs light up for a short period of time. If there are no faults, the SNA-1 is set to the parameters that were selected before switch-off, and the menu appears on the screen (internal battery for data

retention). If you want to select a new operating mode, press MODE MENU [30] (see Figure 2-3). The operating-mode menu appears on the screen; each operating mode is written next to the softkey that is used to select it (see Figure 2-3).

Full measuring accuracy is reached after about 15 minutes.

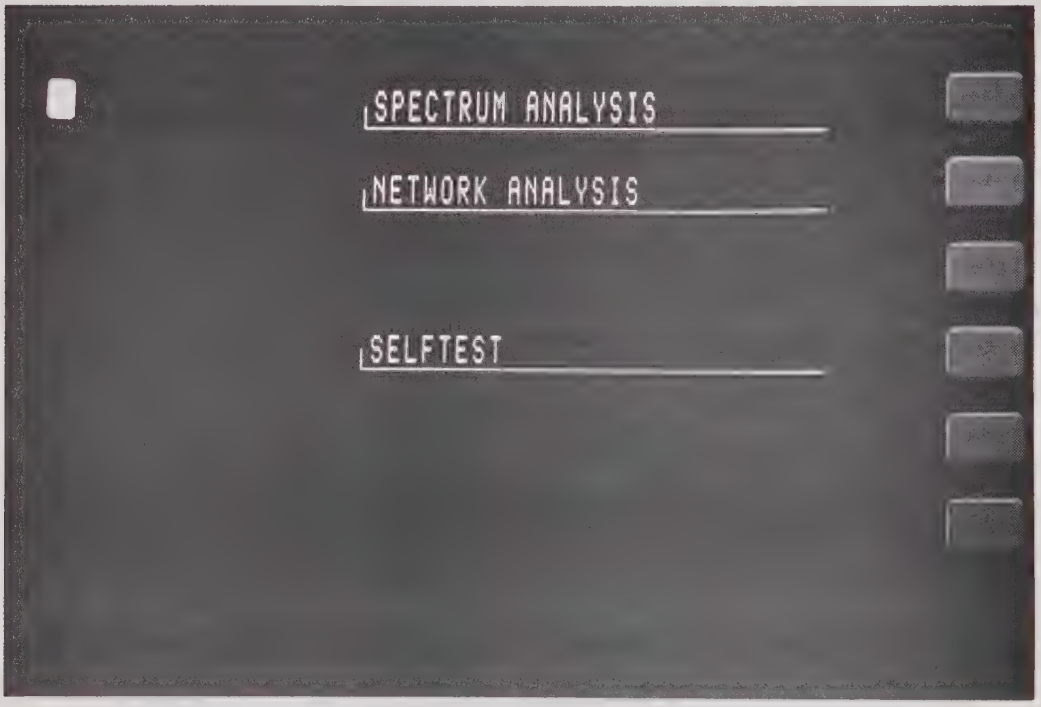


Figure 2-3 Operating-mode menu

2.3 F U S E S

If there is no display when the SNA-1 is switched on, and no LEDs on the front panel light, check the fuses. They can be checked after caps L and U on the back panel have been unscrewed (see Figure 3-2).

Only use fuses of the type listed in section 2.1.4.

2.4 S E L F T E S T

When there is a malfunction, call the self test to check the software.

* Press "MODE MENU" [30]
  - Menu in Figure 2-3 is shown
* Press the "SELF TEST" softkey
  - SELFTEST IN PROGRESS
    ROM ERRIR NO
    appears on the screen

The faulty EPROM is indicated by the error number.

The Service Manual contains more details.

If the self test has been called up after a malfunction, you can return to normal operation by pressing "MODE MENU" [30] (the self test is a programmed loop).

If there is no malfunction and you wish to return to normal operation from the self test, MODE MENU must be pressed longer.

2.5 STANDARD SETUP

All setups are stored in RAMs. A rechargeable battery supplies power to the RAMs when the SNA-1 is switched off. Front panel settings and tolerance masks (address area 1 to 9) are also preserved in memory when the SNA-1 is switched off.

If the SNA-1 has not been used for some time (i.e. more than 30 days), the stored data may be lost. When this happens, and the SNA-1 is switched on again a "standard setup" is activated, which corresponds to the following settings:

- Screen: MODE MENU as shown in Figure 2-3
- Calibration: dBm
- Front panel key functions:
  - A [3] Screen memory A is in use
  - ACTUAL A [7] The current test result is transferred to screen memory A
  - LOCAL [5] Set to manual operaton
  - Automatic calibration on (LED next to the AUTO CAL key OFF
- Internally-set measurement parameters:

- FCENT	= 90 MHz	(centre frequency)	} "Frequency range"
- FSPAN	= 180 MHz	(frequency span)	
- REFERENCE	= 0 dBm	(reference level)	} "Level range"
- SCALE	= 100 dB	(scale range)	
- RBW	= 30 kHz	(resolution bandwidth)	
- VBW	= 50 kHz	(video bandwidth)	
- SWT	= 0.5 s	(sweep duration)	
- INPUT ATT	= 50 dB	(input attenuation)	

The standard setup can also be called up during normal operation (see 3.6.5.1).

2.6 INITIALISATION

Under certain circumstances (e.g. rechargeable battery run down), it may not be possible to operate the SNA-1 from the front panel as it is disabled. A definite initial state can be obtained in the following manner:

Initialisation: (SNA-1 is switched off)

* Hold CLR [32] down
* Press mains ON
* Wait until you hear a beep
* Release CLR [32]

The SNA-1 is now in the standard setup (see 2.5). Any stored front panel settings and the measurement trace M are erased.

3 OPERATING INSTRUCTIONS

3.1 INTRODUCTORY REMARKS

The level range and the frequency range can be entered in a number of ways, so making spectrum analysis and two-port measurements as fast and simple as possible. Using a three-control system you can find and measure spectral lines whose levels and frequencies are not known precisely. The three control knobs are to be found on the right-hand side of the analyser unit. The frequency range is determined by adjusting the start frequency (FSTART) or the centre frequency (FCENT), or by switching the frequency span (FSPAN). The third knob is used to offset the reference level vertically (REFERENCE). In this way, an optimal level range setting is obtained (see 3.6.5.2).

When the level and frequency of the spectral lines are known, the frequency and level can be entered directly via the digital keypad which is to be found on the left-hand side of the analyser unit. Frequently-used settings can be stored, and called up via the MEMORY keys. There are six softkeys beside the right-hand edge of the screen. The functions of the softkey vary depending on the measurement mode. The front panel of the display unit has keys for selecting the measurement trace and also special-function keys for an optimal evaluation of the measurement trace.

Most of the analog and the digital signal connectors are on the back panel of the SNA-1. Connections between the analyser unit and the display unit are made by means of special cables, (see Figures 2-2 and 3-2). The connector for the IEC/IEEE bus and the mains connectors and controls are also on the back panel.

The symbols for the SNA-1's controls, indicators and connectors are shown in Figures 3-1 and 3-2.

Each control, indicator or connector on the front or back panel of the SNA-1 has a number in a box next to it. By looking up this number in the tables provided, you will be able to find out what the function of the element is; the numbers in brackets indicate where more information may be obtained.

All coaxial connectors use the Versacon Universal Connector System, and so can be easily adapted to all commercially available connector types.

3.2 ABRIDGED OPERATING MANUAL

An abridged operating manual is contained in the drawer at the base of the instrument. Pull out the drawer as far as it will go, the instruction card you want can then be read by pushing back the cards on top of it. When the drawer is closed and re-opened, all the cards are at the front of the drawer again. A thumb-index helps you to find the card you want.

The instruction cards are in two languages, English on one side, and German on the other. The card stack can be turned over using the slot provided in the bottom of the drawer.

The abridged operating manual tells you how to set the measurement parameters for spectrum and network analysis (tabular form), how to set up the SNA-1, and how to perform fast overview measurements (standard setup). The manual also contains information about the display menu, and about tolerance masks etc.

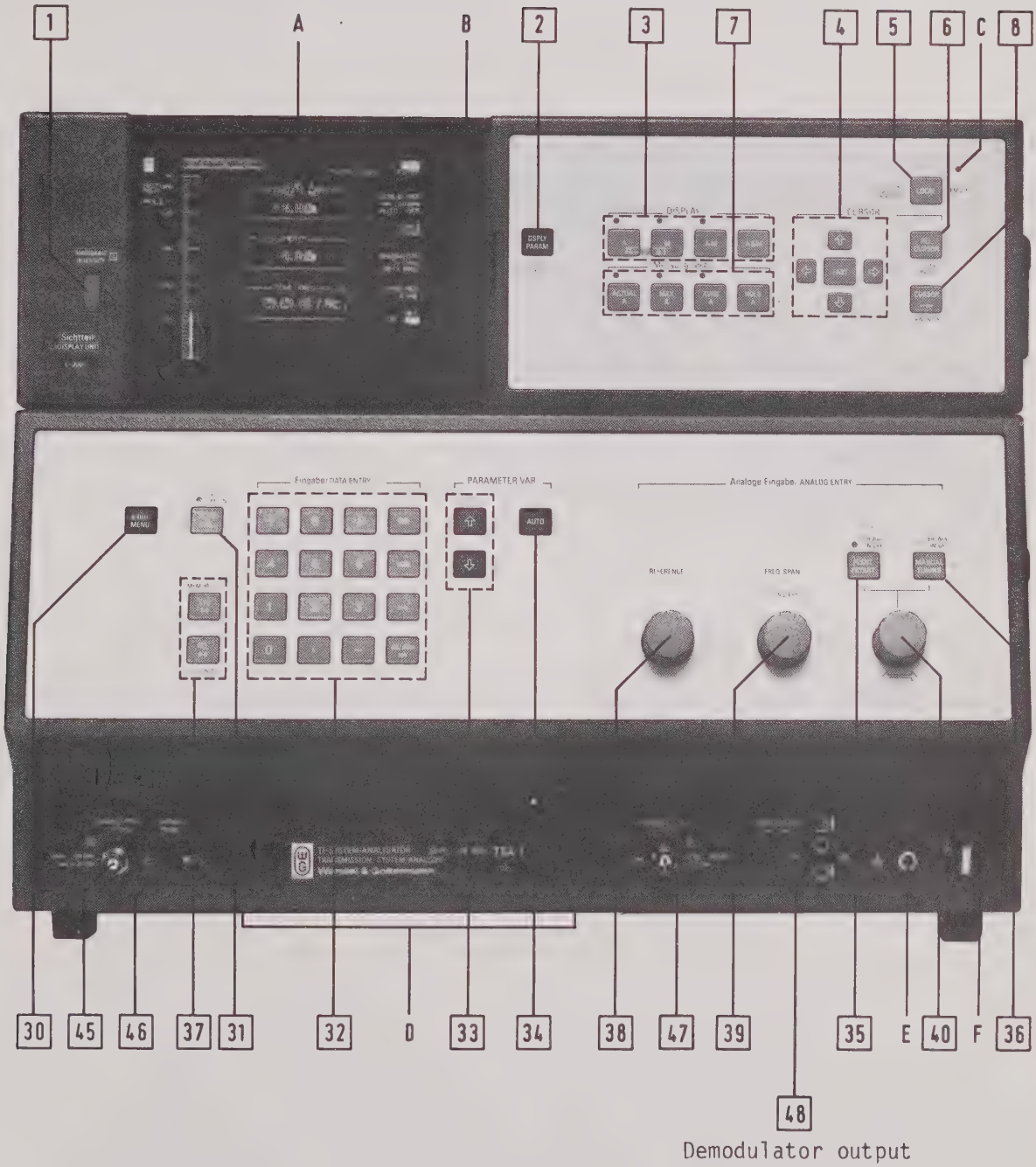


Figure 3-1 Front view of the TSA-1

3.3 CONTROLS, INDICATORS AND CONNECTORS

3.3.1 CONTROLS, INDICATORS AND CONNECTORS ON THE FRONT PANEL, FIGURE 3-1

Code	Key symbol	Function
[1]		Brightness
[2]	DSPLY PARAM	DISPLAY PARAMETER: display menu for calling up auxiliary functions, e.g. scale calibration, tolerance masks, graphics plotter control (cf. 3.5).
[3]		DISPLAY: displays screen memory A or screen memory M when the correct key is pressed (cf. 3.9)
	A A→	Screen memory A (standard setup) is displayed, screen contents (measurement trace) are selected via key-bank [7]
	M M	Displays memory M, the contents of A are transferred (if A and M is pressed simultaneously).
	A-M	Difference trace, current trace minus stored trace.
	A&M	The current trace and the stored trace are displayed simultaneously
[4]		CURSOR: Line cursors that can be positioned anywhere on the screen grid. If a key marked with an arrow is pressed simultaneously, the value indicated by the cursor is shown numerically on the screen.
		Purpose of arrowed-keys:
	⇦ ⇨	Frequency cursor (vertical line) can be moved to the right or to the left.
	⇧ ⇩	Level cursor (horizontal line) can be moved up or down
	FAST	By pressing the FAST key and a cursor key, the cursor can be moved rapidly.
[5]	LOKAL	Switches to manual control (if the SNA-1 is being remote controlled via the IEC bus)

Table 3-1 Controls, indicators and connectors on the SNA-1's front panel

Code	Key symbol	Function
[6]	REL CURSOR	RELATIVE-CURSOR: when this key is pressed, a 2nd frequency cursor or a 2nd level cursor is displayed on the screen, the value difference between the two cursor lines is also shown on the screen. MEASUREMENT: updates the trace
	ACTUAL A	Current measured result, the trace is updated by each new sweep (3.10.1)
	MAX A	Storage will not take place unless the current value is greater than the stored value (3.10.2)
[7]	AVRG A	Cumulative digital averaging after each new sweep (3.10.3)
	HOLD A	Freezes the current screen display (3.10.4)
[8]	CURSOR	CURSOR transfer: the value shown by the frequency marker can be used as the new start/stop/centre frequency (selection via display menu [2]). The value shown by the level cursor can be used as the new reference level.
[30]	MODE MENÜ	Lists all the operating modes (2.2)
[31]	AUTO CAL	Switches the automatic calibration on or off (on if LED is off), (3.8.5)
	0 … 9	DATA ENTRY (3.6.5.3) Numerical keypad for entering measuring parameters, tolerance masks set up addresses
[32]	MHz kHz dBm	Keys for terminating numerical entries
	CLR	Clears incorrectly entered numbers with mains key: re-initialisation
[33]	⇧ ⇩	STEP: Measuring parameters can be increased or decreased by a fixed step; type selected via softkeys (3.6.5.3) Increases the parameter by one step Decreases the parameter by one step } size of step determined internally

Table 3-1 Controls, indicators and connectors on the SNA-1's front panel (continuation)

Code	Key symbol	Function
[34]	AUTO	Automatic control of parameters that are not independent of each other (3.6.4) (i.e. selecting a suitable freq. span or ref. level) - RBW (resolution bandwidth) - VBW/SWT (video bandwidth/sweep duration) - INPUT ATT (input att)
[35]	FCENT FSTART	Key that has to be pressed before carrying out analog frequency entries with knob [40]. FCENT or FSTART is selected via menu.
[36]	MANUAL TUNING	Key that has to be pressed before tuning the measuring frequency by means of knob [40]
[37]	STO 1-9	MEMORY: stores complete setups in the address range 1 to 9 (3.6.5.5) stores the front-panel setup (press the number-key afterwards)
	RCL 0-9	Recalls front-panel setups (press number-key afterwards) Address 0: standard setup (see 3.6.5.1) Address 1 ... 9: setup that can be defined by the user
[38]	1)	Reference level: Quasi-analog setting without preselection via softkeys (Reference line at 0 dB on graticule).
[39]		Frequency span: Quasi-analog setting without preselection via softkeys
[40]	1)	Centre frequency (or start frequency): analog setting without preselection via softkeys (key [35] ON) Manual sweep if key [36] is ON

Table 3-1 Controls, indicators and connectors on the SNA-1's front panel (continuation)

1) The arrows show in which direction the trace moves

Code	Function
[45]	Test input: 100 Hz to 180 MHz, impedance 75 Ω (50 Ω), universal connectors with BNC inserts
[46]	Connector for the power supply to the TK-11 Active Test Probe
[47]	Tracking generator output: 10 kHz to 180 MHz, fixed level -15 dBm, impedance 75 Ω (50 Ω), universal connector with BNC insert
A	7"flat screen, complies with CCIR TV recommendations, Standard B - displays results using an electronically calibrated internal graticule - measurement parameters shown on screen - parameter lists to help the operator
B	Softkeys: 6 unlettered keys, the function of the keys depends on the operating mode which has been selected (function is shown on screen)
C	Indicator lamp, comes on when the SNA-1 is remote controlled via the IEC/IEEE bus
D	Drawer for abridged operating instructions
E	Earth connector
F	Mains on/off switch

Table 3-1 Controls, indicators and connectors on the SNA-1's front panel (continuation)

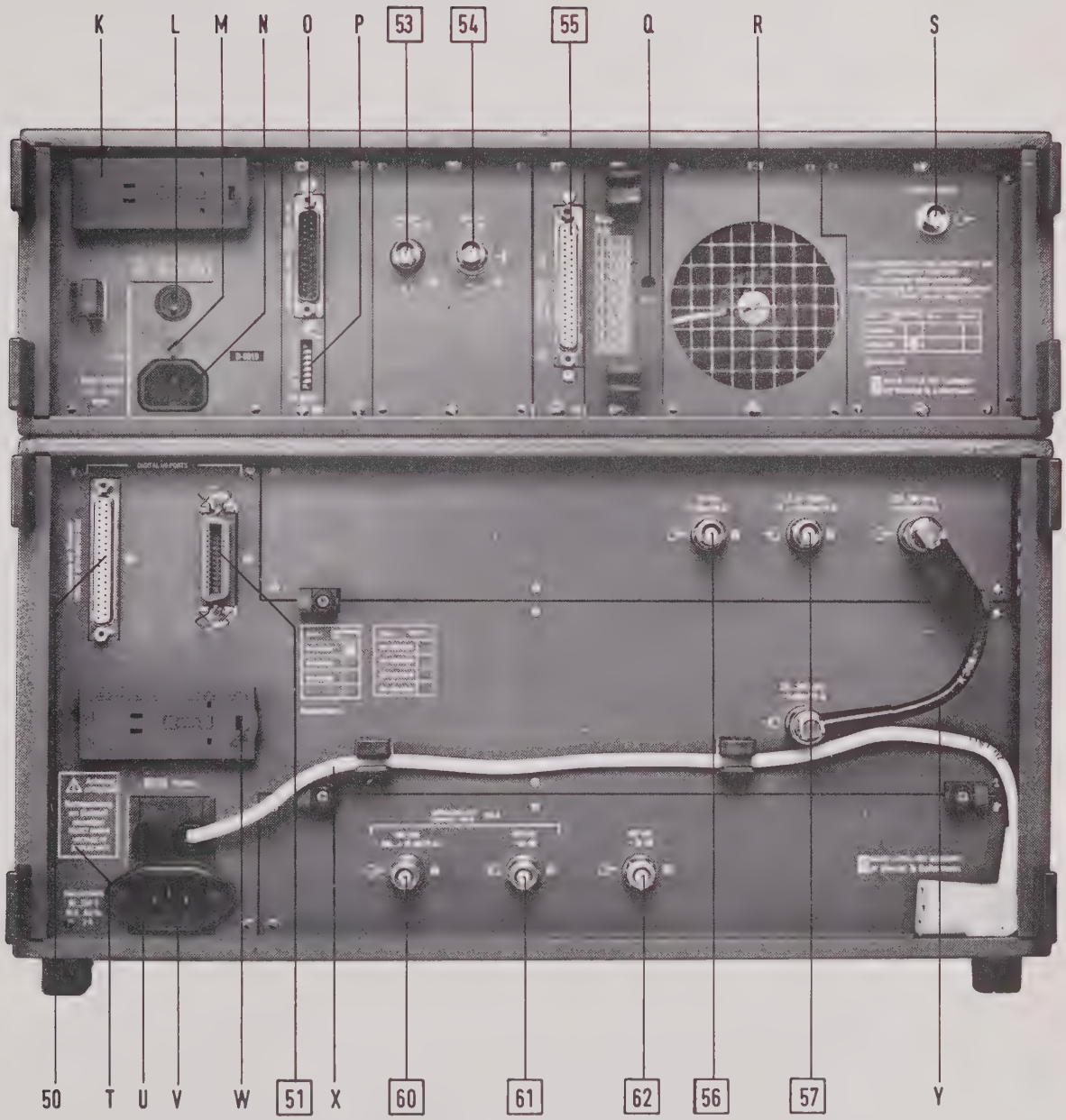


Figure 3-2 Rear view (no cabling)

3.3.2 CONNECTORS AND OTHER CONTROL ELEMENTS ON THE BACK PANEL OF THE SNA-1, FIGURE 3-2

Code	Function
[50]	Digital interface (data and address bus), for connection to [55]
[51]	Digital interface for controlling a relay changeover switch (in preparation), 24-pole Amphenol connector
[53]	Input for a 400 kHz IF; must be connected to [60]
[54]	Output for a 400 kHz IF; must be connected to [61]
[55]	Digital interface (data and address bus)
[56]	Standard frequency output 10 MHz
[57]	Input for external standard frequencies; 1, 2, 5 or 10 MHz
[60]	Output for a 400 kHz IF, must be connected to [53]
[61]	Input for a 400 kHz IF, must be connected to [54]
[62]	Output for 400 kHz IF
K	Compartment for spare fuses, various keys and board extractor
L	Mains fuse (display unit)
M	Mains-voltage selector switch
N	Mains connector (display unit)
O	Connector for the <IEC 625> bus, IEEE 488 connector
P	Switch for the IEC bus address system controller mode
Q	Potentiometer (for setting the level of the video-signal)
R	Fan
S	Video output for external monitor or video-printer
T	NB: Set mains voltage on display unit
U	Mains fuse (analyser unit)
V	Mains connector (analyser unit)
W	Compartment for spare fuses, various keys and a board extractor
X	Mains cable for supplying the display unit (connector N)
Y	Control-frequency connection [52]-[58]

3.3.3 TEST CONNECTORS

3.3.3.1 Test input [45]

The SNA-1 has a coaxial input [45] with an impedance of 75 Ω (or 50 Ω) for frequencies between 100 Hz and 180 MHz. For high-impedance, low-capacitance measurements, the TK-11 Active Test Probe can be used in conjunction with the 75-Ω version. The probe is connected to input connector [45] (BNC) and to test probe conector [46] (power supply).

N.B. D.C. voltages, and levels greater than 20 dBm or 11 dB should not be applied to the test input [45].

3.3.3.2 Tracking generator output [47]

In the operating mode "network analysis" (see 3.7) the test signal to the two-port under test is supplied from coaxial output [47]. The internal tracking generator produces a sinusoidal signal with a fixed level of -15 dBm in the frequency range 10 kHz to 180 MHz.

3.4 OPERATING METHOD

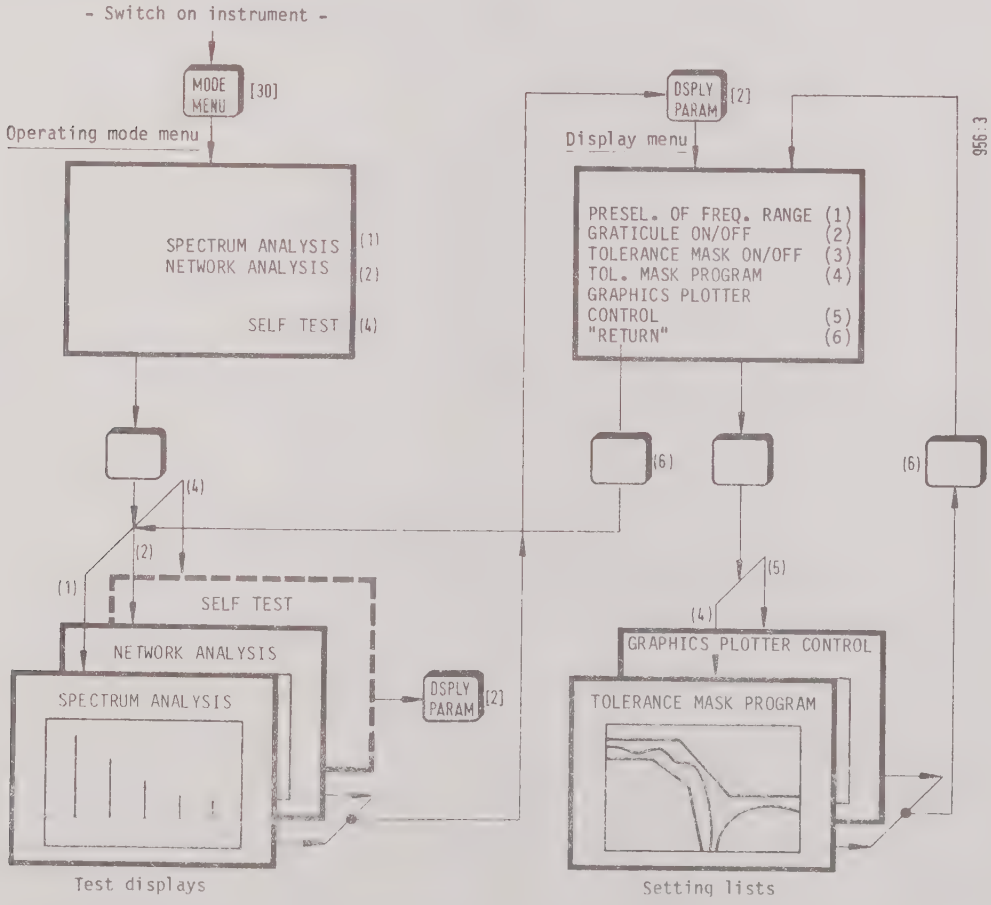


Figure 3-3 The menu structure of the SNA-1 (BN 956/01)

3.4.1 MENU STRUCTURE

Before dealing with the operating procedures and settings in detail, we will describe the basic menu structure (Figure 3-3) of the SNA-1 (01 version). Two basic menus can be called up by means of the keys provided.

- "MODE MENU [30]": for selecting the measurement mode and the parameters in each mode.
- "DISPLAY MENU [2]": auxiliary functions that help the user choose the screen format he requires, and that control a graphic plotter

3.4.2 SOFTKEYS

When you press the MODE MENU [30], the operating mode list is shown on the screen, see Figure 2-3. Using the softkeys along the right-hand edge of the screen you can select the operating mode you require. The measurement display on the screen then shows you the relevant measuring parameters. The values of these parameters depend on the front panel setup which was last selected. The functions of the softkeys will now have changed. The abbreviations used to describe the parameters will be explained when each operating mode is explained, see 3.6.2 and 3.7.2. In the following sections we will adopt the practice of using the abbreviations as they appear on the screen.

If you want to change a measuring parameter, press the relevant softkey (if the softkey has a double function you must press it twice). The selected measuring parameter is shown in reverse video on the screen. Now you can enter the new parameter value using the numerical keypad [32] or via the step-keys [33].

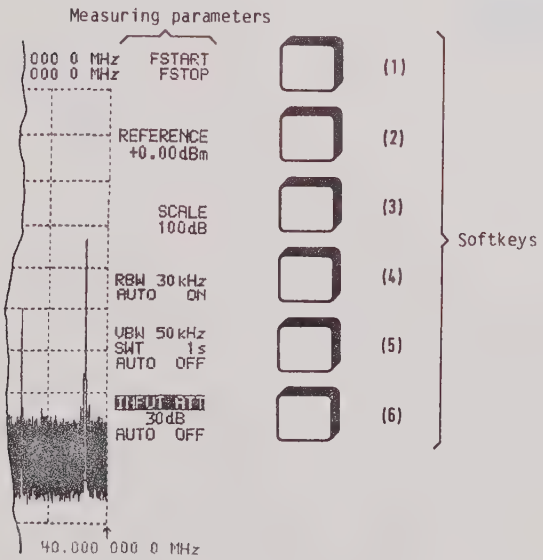
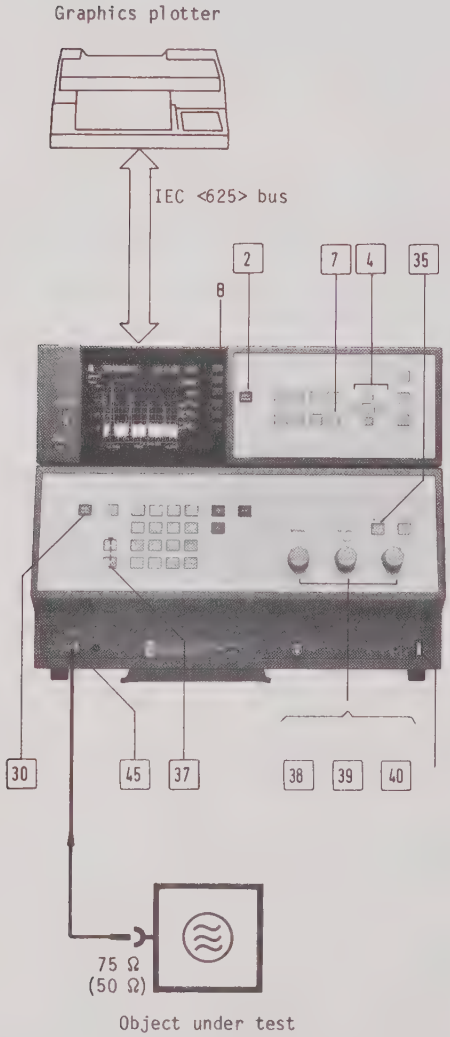


Figure 3-4 Softkeys for selecting the measuring parameters

3.4.3 OPERATING PROCEDURE (GENERAL)

The following listing shows you roughly how to carry out spectrum analysis and how to obtain a graphic display. A detailed description is not given here, but references in brackets tell you where more information may be obtained.



* Switch on the SNA-1 (key [F])
* Connect item under test to connector [45]
* Set the maximum level and frequency range on the test-display: basic setting [37] (3.6.5.1)
* Select the spectrum analysis operating mode via MODE MENU [30] (3.6.1)
* Shift the spectrum into the display range: 3-key operation (key [35] on) (3.6.5.2)
* Measure the frequency and level of the spectral lines = CURSOR [4] (3.11)
* Freeze the display: HOLD A [7] (3.10.3)
* List the display start the plotter via the display menu [2] (3.13.2)

[ ]: Key lettering

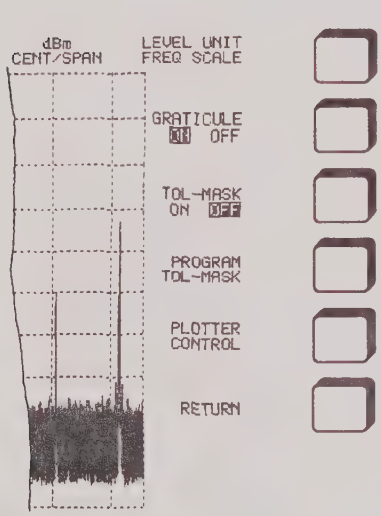
1) The graphics plotter is controlled via the IEC/IEEE bus board (BN 958/01, option).

3.4.4 INCORRECT ENTRIES

- An incorrect entry, e.g. an out-of-range measuring parameter, or an illegal key sequence, is indicated by a beep.
- Level entries that are out of range (REFERENCE and INPUT ATT settings) are shown by an "OUT OF RANGE" message on the screen. The parameter causing the out-of-range message is marked with a "*".

3.5 D I S P L A Y P A R A M E T E R M E N U (DISPLAY PARAMETER [2])

After the display menu has been called up by pressing "DISPLAY PARAM" [2], the following special functions can be selected. The trace is still displayed on the internal graticule. When the selected function has been performed, press softkey (6) "RETURN" to return to the measurement display.



Absolute level calibration in "dBm" or "dB"

(1) — Frequency entry: Preselect the parameter pair for the frequency range to be displayed (see 3.5.2)

(2) — Internal graticule can be switched on or off (see 3.8)

(3) — Tolerance mask can be switched on or off (see 3.12)

(4) — Tolerance mask programming (see 3.12)

(5) — Graphics plotter control (see 3.13.2)

(6) — Return to test display (see 3.6.1, 3.7.1)

Figure 3-5 Display menu and available functions

3.5.1 POWER LEVEL - (dBm) AND VOLTAGE LEVEL CALIBRATION (dB)

The absolute power level (dBm) calibration or the voltage level (dB) or (dBµV)[1] calibration of the SNA-1 is defined via the display menu, see Figure 3-5

1) 0 dBm ≅ 108.75 dBµV

* Press softkey (1) LEVEL SCALE once (reverse video)

* By pressing STEP key [33] dBm or dB calibration can be selected; see display

The SNA-1's standard setup is calibrated in dBm; cf the measurement ranges in 1.2.1.1.

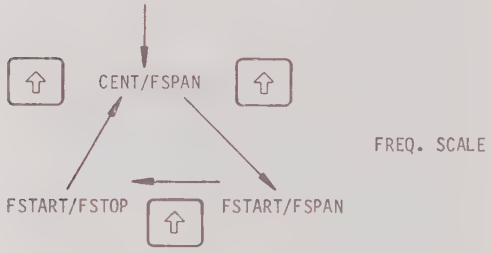
3.5.2 ENTERING THE FREQUENCY RANGE

The frequency range is defined by entering a number pair. There are three combinations which can be selected by means of the display menu. (see Figure 3-5).

* Press softkey (1) FREQ. SCALE (reverse video)
  Press the STEP key [33] until you get the combination you want:

  - Start frequency and stop frequency entry (FSTART/FSTOP)
  - Start frequency and frequency span entry (FSTART/FSPAN)
  - Centre frequency and frequency span entry (FCENT/FSPAN)

The display for the standard setting is shown (RCL 0)



In the standard setting (see 3.6.5.1), the FCENT/FSPAN combination is set. If the start frequency (FSTART) and the stop frequency (FSTOP) are to be entered, proceed as follows:

* Press " ⇧ " [33] twice ● START/STOP displayed on screen
* Press softkey (6) RETURN ● Test display is shown on screen
* Press softkey (1) FSTART ● Reverse video display
* Enter the FSTART value via the numerical keypad
* Press softkey (1) FSTOP ● Reverse video display
* Enter the FSTOP value via the numerical keyboard.

NOTE: The frequency values are then entered via the controls on the analyser unit.

FCENT/FSPAN:
- Knob [39], [40] (key [35] "on")
- Numerical keyboard [32] (preselection via softkeys)
- Increment keys [33] (preselection via softkeys)

FSTART/FSPAN:
- Knobs [39], [40], (key [35] "on")
- Numerical keyboard [32] (preselection via softkeys)
- Increment keys [33] (preselection via softkeys)

FSTART/FSTOP:
- Numerical keyboard [32] (preselection via softkeys)

3.6 SPECTRUM ANALYSIS OPERATING MODE

3.6.1 SPECTRUM ANALYSIS TEST DISPLAY

The spectrum analysis operating mode is called up in the following manner:

* Press MODE MENU [30]
* Press softkey (1)

Apart from the results (trace), the following are also shown in the test display:

- Electronically calibrated and lettered internal graticule (cf 3.8)
- Measurement parameters (cf 3.6.2 and 3.6.3), i.e. the current SNA-1 settings
- The selected screen-store (e.g. ACTUAL M, cf 3.9)
- Any other function that has been switched on (e.g. HOLD)

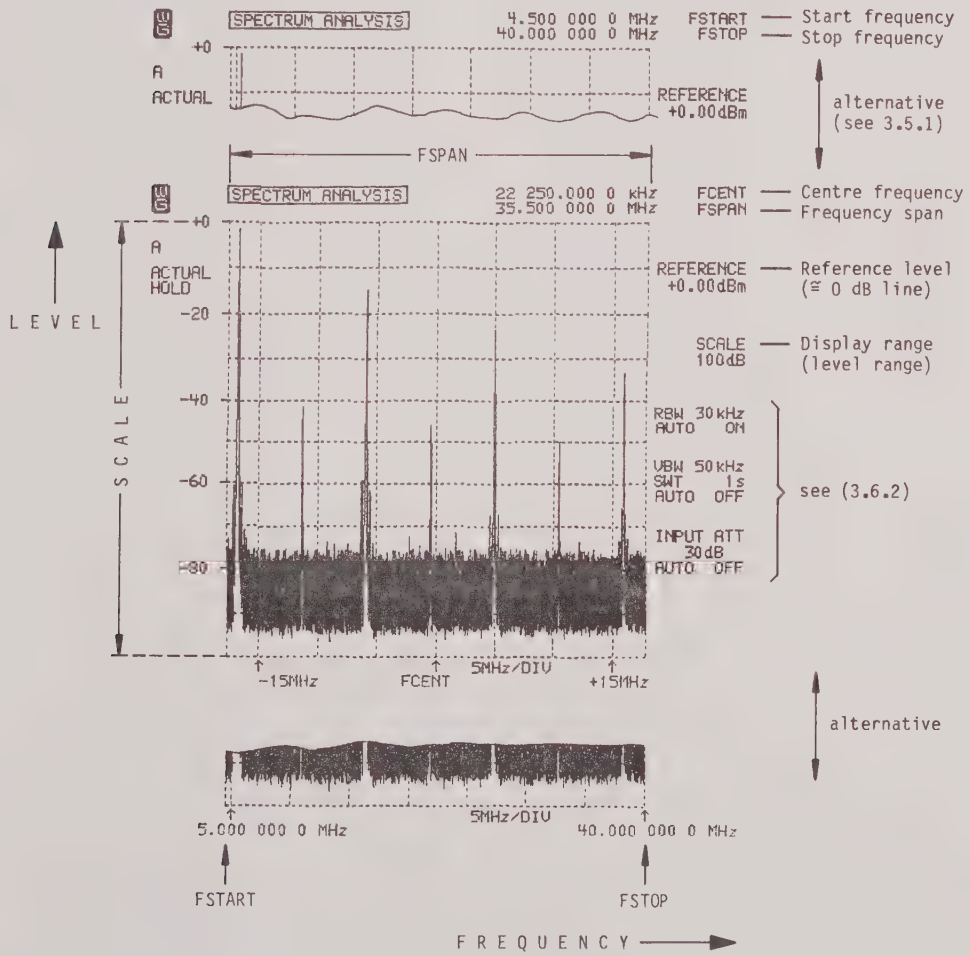


Figure 3-6 Spectrum analysis test screen

3.6.2 SPECTRUM ANALYSIS MEASURING PARAMETERS

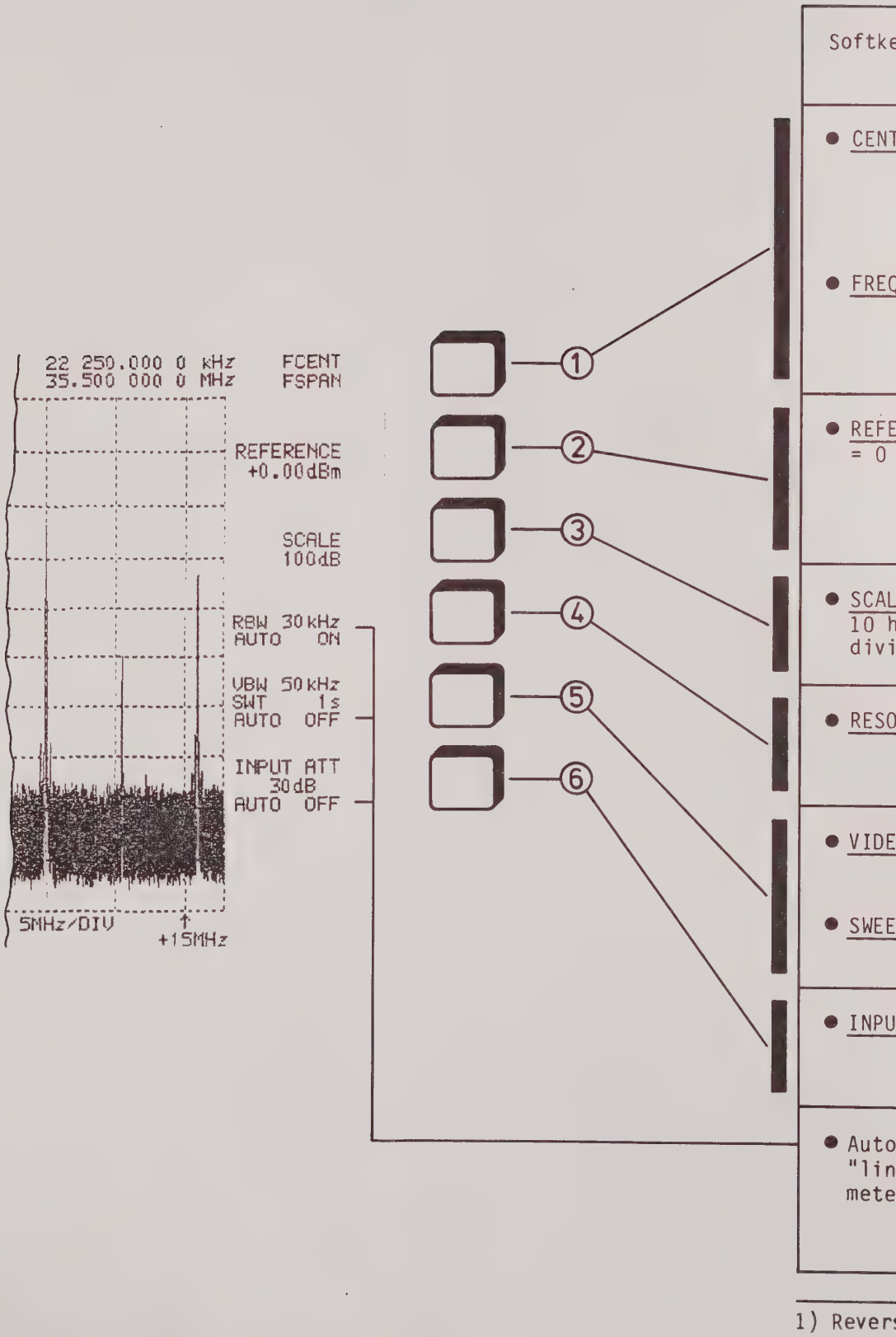


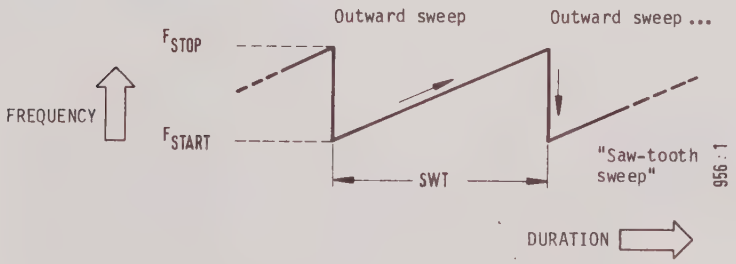
Figure 3-6a Setting the measurement parameters via the softkeys

	Selection[1] (press softkey)	Parameter value entered via	Remarks
CY	(1) : once	Numerical keyboard [32] or via cursor transfer (cf 3.11.3)	FSTART/FSTOP FSTART/FSPAN combination via display menu [2]
	(1) : twice	Numerical keyboard [32] or STEP keys [33] (in 1-2-5 sequence)	Analog by means of knobs [39], [40] (no preselection via softkeys)
	(2) : once	Numerical keyboard [32] or STEP keys [33] (constant increments) or cursor transfer (cf 3.11.3)	Analog entry is possible Knob [38] (no preselection via softkeys)
	(3) : once	STEP keys [33] (in 1-2.5-5 sequence)	——
DWIDTH	(4) : once	STEP keys [33] (in 1-3-10 sequence)	RBW and FSPAN are jointly set when AUTO ON
H	(5) : once	STEP keys [33] (in 5-15 sequence)	VBW and SWT are linked to RBW and REFERENCE when AUTO ON
	(5) : twice	STEP keys [33] (in 2-5-10 sequence)	
ION	(6) : once	STEP keys [33] (in constant steps)	INPUT ATT is linked to REFERENCE and RBW when AUTO ON
	via the AUTO key [34] when the measuring parameters are preselected	——	The automatic mode can be switched on for each of the softkeys (4), (5), (6)

——

3.6.3 EXPLANATION OF THE MEASUREMENT PARAMETERS

- FCENT (centre frequency): See Figure 3-6 and 1.1.2.1
- FSPAN (frequency span): See Figure 3-6 and 1.1.2.2
- FSTART[1] (start frequency): FCENT - FSPAN/2, cf Figure 3-6 and 1.1.2.1
- FSTOP[1] (stop frequency): FCENT + FSPAN/2, cf Figure 3-6 and 1.1.2.1
- REFERENCE (reference level):
  - The reference value is set by the user
  - Corresponds to the 0 dB line on the screen
  - Also see 1.2.1.2
- SCALE (scale range):
  - Selects the display range for the level (difference between the upper and lower grid line)
  - Also see 1.2.1.2
- RBW (resolution bandwidth): Selective filter
  - RBW << FSPAN, to obtain high resolution
  - See 1.1.5
- VBW (video bandwidth):
  - Low-pass for smoothing noisy signals (VBW corresponds to limit frequency)
  - See 1.4.2
- SWT (sweep duration):
  - Time elapsed between FSTART and FSTOP



- See 1.4.1 -

- INPUT ATT (input attenuation):- The test signal is attenuated by means of an input attenuator so that the input signal drives the input mixer correctly.

---

1) The display menu gives an alternative display to FCENT/FSPAN, DISPLY PAR. key [2].

3.6.4 AUTOMATIC-MODE PARAMETERS

● RBW, SWT, VBW:

The measurement parameters: ●resolution bandwidth (RBW)
●video bandwidth (VBW)
●sweep duration (SWT)

are linked with the frequency span (FSPAN), when the softkeys (4) and (5) are switched to the automatic mode ((4) and (5) do not both need to be switched to automatic mode).

Setting: (the SPECTRUM ANALYSIS test-screen is shown)

* Press softkey (4)
* Press AUTO [34] → ● RBW␣ ← Optimal
AUTO ON Resolution bandwith

* Press softkey (5)
* Press AUTO [34] → ● VBW␣ ← Optimal video bandwidth
SWT␣ ← Optimal sweep time
AUTO ON

When the frequency span is changed the following are automatically set:

- Optimal settling time: RBW opt
- Short sweep: SWT opt (sweep curve is frequently refreshed)
- Optimal noise averaging: VBW opt

The automatic mode is especially useful for overview measurements, if FSPAN is varied over a large range (in a short time) by means of knob [39]. (cf 3-knob operation in 3.6.5.2).

> In the standard setting (display of the maximum level and frequency range see 3.6.5.2), the automatic mode operated for all three parameters (also INPUT ATT).

● INPUT ATT

When the automatic mode is switched on, the input attenuation is set so that the mixer is always operating at the correct point on its characteristic, i.e. the best compromise between the best signal to noise ratio and the best harmonic ratio (see figure 3-7).

The level of the input signal can therefore be the same as, or smaller than, the reference level.

Setting: (test screen SPECTRUM ANALYSIS)

* Press softkey (6)
* Press AUTO [34] → ● INPUT ATT
␣ ← Optimal input attenuation
AUTO ON

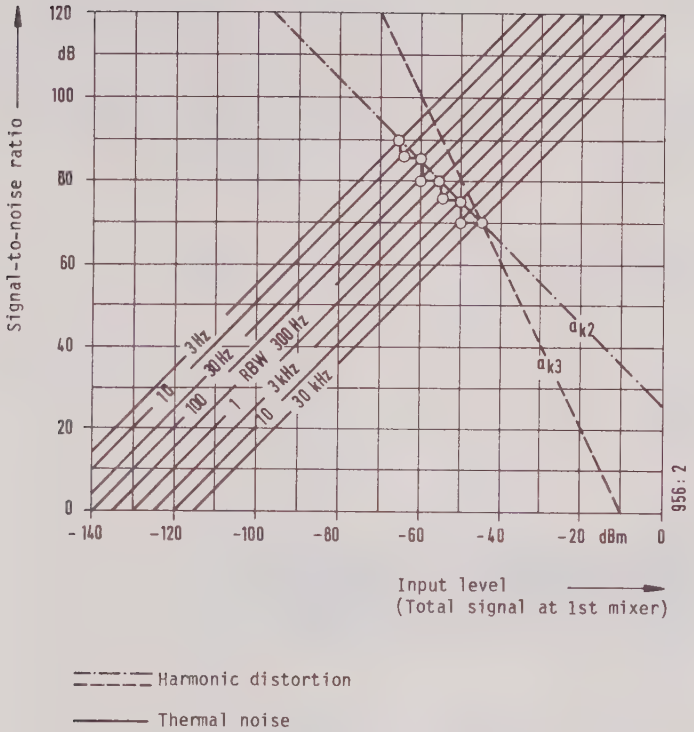


Figure 3-7 Dynamic range of the SNA-1

3.6.5 PARAMETER SETTING

3.6.5.1 Standard setting (cf 2.5)

To find signals whose exact frequency and level are not known, it is best to set the maximum frequency and level range on the SNA-1.

This is one of the purposes of the standard setup which is stored at address 0. All the measurement parameters are set to default values:

FCENT	=	90 MHz	shown in the test display
FSPAN	=	180 MHz	
SCALE	=	100 dB	
REFERENCE	=	0 dBm	
AUTO ON (RBW, VBW, SWT)			
ACTUAL A	=	current measurement result	
A	=	screen memory A	

● Call-up

* Press RCL 0-9 [37]

* Press 0 [32] ● The test screen SPECTRUM ANALYSIS is displayed.

The test signal, in particular the 10 MHz line, can be seen, and using the 3-knob control (cf 3.6.5.2) can be brought into the correct frequency range (shift signal to centre of screen FCENT [39] and reduce FSPAN [40]).

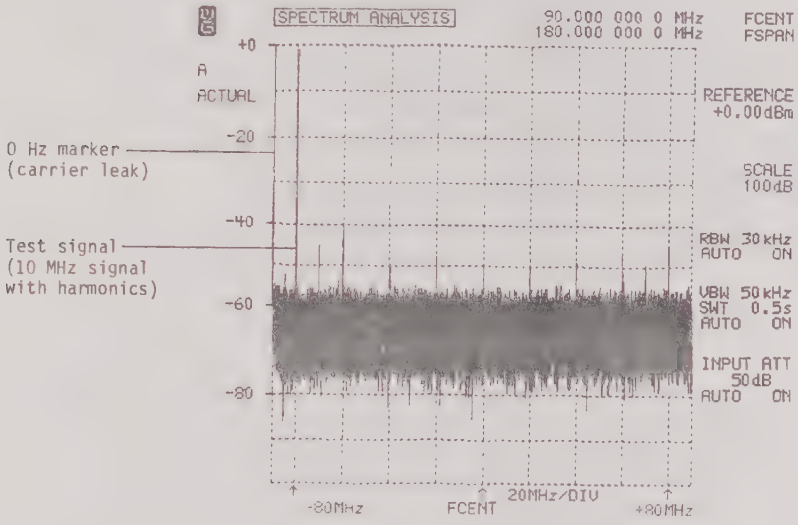


Figure 3-8 SNA-1's standard setup, suitable for overview measurements

3.6.5.2 3-knob operation

The 3-knob operating mode can be used to analyse spectra and spectral components quickly.

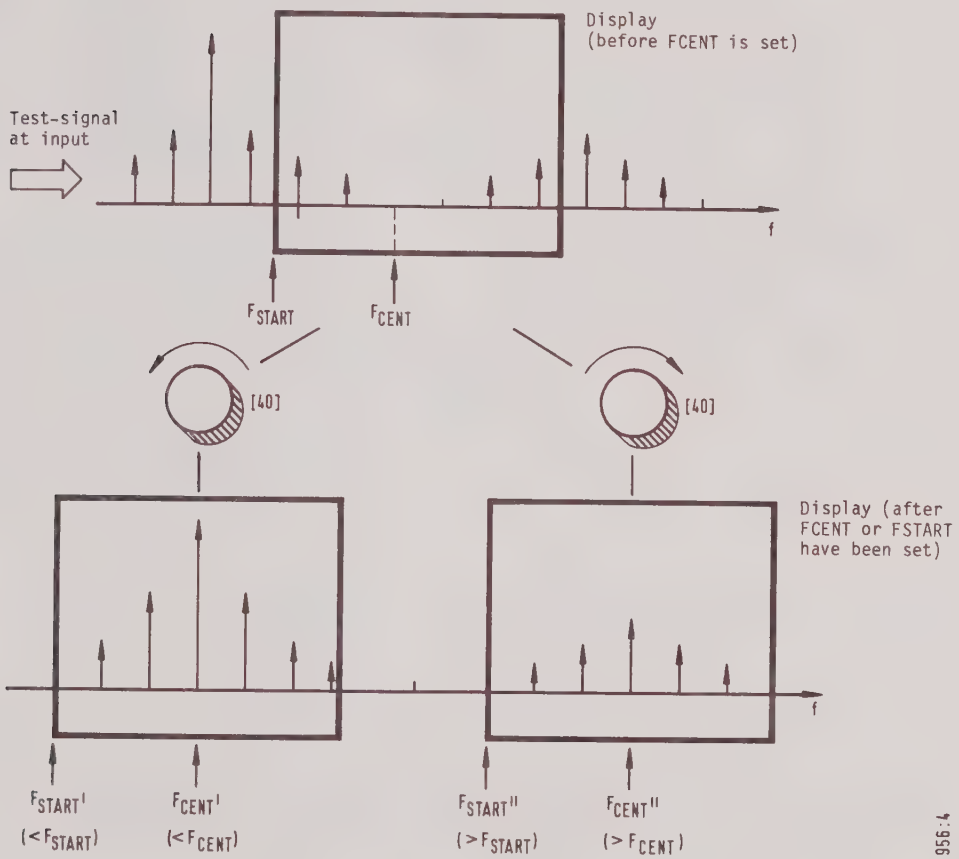
The following settings can be made:

- Centre frequency (FCENT) or start frequency (FSTART)
- Frequency span (FSPAN)
- Reference level (REFERENCE)

It is a good idea to switch on the automatic mode for RBW, SWT/VBW and INPUT ATT (cf 3.6.4).

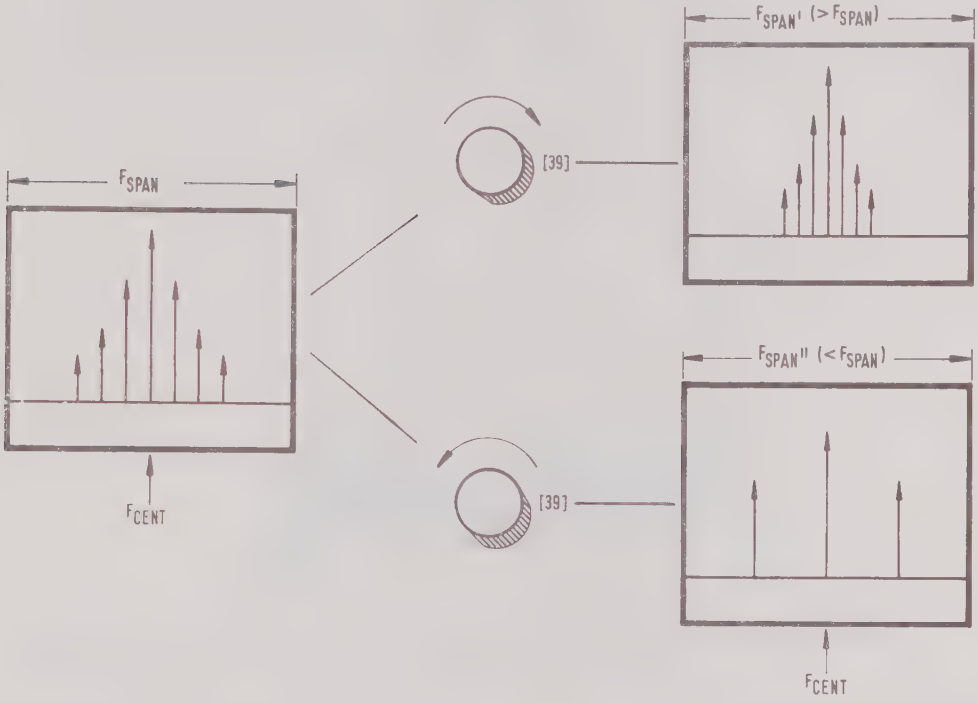
FCENT/FSTART: Fast setting of the centre frequency or the start frequency. The spectrum can be moved in one of two directions over the screen; the frequency span (FSPAN) stays the same.

* FCENT (FSPAN) or FSTART (FSPAN) entry is preselected via the display menu (see 3.5.1).
* Press FCENT/FSTART [35] (LED on)



NOTE: After the analog settings FCENT or FSTART have been made, key [35] should be pressed to prevent incorrect settings should knob [40] be accidently touched.

FSPAN: Fast adjustment of the frequency span in 1-2-5 sequence.
The frequency range to be displayed can be increased or decreased in steps using this setting.



REFERENCE: Fast adjustment of the reference value in steps up to 10% of the scale range (1 division/step).

[38] Increases reference level (trace is shifted downwards)

[38] Decreases reference level (trace is shifted upwards)

NOTE: - When the 3-knob mode is used to analyse spectra, it is best to switch in the automatic mode for all parameters; see 3.6.4.
- If the frequency range is set using the FCENT/FSPAN combination, (alternate adjustment of FCENT/FSPAN) there is no need to press the softkey.

3.6.5.3 Operating the keyboard (numerical entries)

Parameter entry is preselected via the softkeys

Numerical keyboard [32]

The following measurement parameters can be entered:

● FCENT	(0.1 Hz)	Resolution
● FSPAN	(0.1 Hz)	
● FSTART	(0.1 Hz)	
● FSTOP	(0.1 Hz)	
● REFERENCE	(0.01 dB)	

Entry (The SPECTRUM ANALYSIS test screen is displayed)

* Press the correct softkey (it may be necessary to press the key twice if it has a double function)

● Measurement parameter is shown in reverse video

* Enter the number via [32]
  - If you have made an incorrect entry, press the CLR key
  - Enter the decimal point with the "." key
  - Terminate the entry with "MHz"/"kHz"/"dBm"/dB/mV

STEP keys [33]

The following measurement parameters can be incremented with the " ⇧ " key, and decremented with the " ⇩ " key.

● FSPAN	(1-2-5 sequence)	
● REFERENCE	(1 div/step)	
● SCALE	(1-2.5-5 sequence)	from 1 dB to 100 dB
● RBW	(1-3-10 sequence)	from 3 Hz to 30 kHz
● VBW	(5-15 sequence)	from 5 Hz to 150 kHz
● SWT	(1-2-5 sequence)	from 200 ms to 20 h
● INPUT ATT	(in 5 dB steps)	from 0 to 65 dB

NOTE: If the parameters RBW, VBW/SWT and INPUT ATT are to be changed, when the automatic mode has been selected, they can be increased or decreased by pressing the STEP keys [33].

3.6.5.4 Cursor transfer

The cursor transfer mode is another way of entering measurement parameters. Cursor positions can be used to define the following parameters:

● FCENT	Frequency cursor
● FSTART	
● FSTOP	
● REFERENCE	Level cursor

More details are to be found in 3.11.3

3.6.5.5 Complete front panel setups

Frequently-used setups can be stored and recalled at a later date. A total of nine setups can be stored (addresses 1 to 9).

- Set all the parameters once
- Store for repeated use later

Tolerance masks (see 3.12) can also be stored as part of the front panel setups.

Storing front panel setups

* The measurement parameters are entered as described in 3.4.5.2 and 3.4.5.3 (functions such as MAX A and AVRG (see 3.10) can also be included in the setup).
* Press STO 1-9 [37]
* Press a numbered key (1 ... 9)

● There are nine addresses for storing up to nine setups

N.B. If a setup has been stored at a certain address, and a new setup is entered at this address, the old setup will be overwritten.

Calling up a setup

* Press RCL 0-9 [37]
* Select the correct address (1. ... 9)[1] by pressing a numbered button.

3.6.6 MANUAL TUNING

Apart from the continuous sweep mode, it is also possible to tune through the set frequency range manually. The test frequency is shown by a marker (X) on the trace.

* Press MANUAL TUNING [36], LED on
* [40]
  - Turn clockwise to increase the frequency
  - Turn anti-clockwise to decrease the frequency

1) After the SNA-1 has been re-initialised, the standard setup is stored at the addresses (1 ... 9).

3.7 NETWORK ANALYSIS MODE (FREQUENCY RESPONSE MEASUREMENTS

3.7.1 TRACKING GENERATOR OUTPUT

The characteristics of filters, amplifiers and other circuits which have the same input and output frequency can be easily determined with the internal tracking generator. Output [47] is a fixed level output for frequency response measurements from 10 kHz to 180 MHz. The output level is -15 dBm, the output impedance in the standard version is 75 Ω.

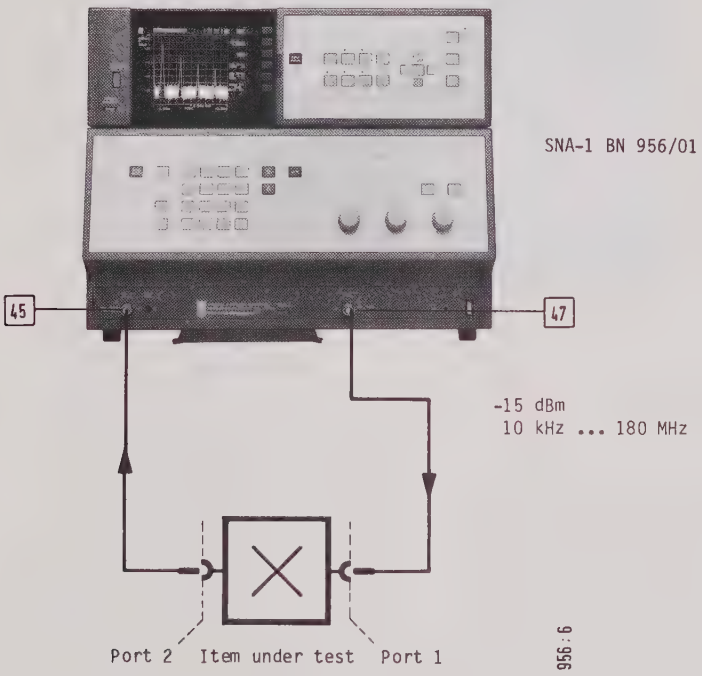


Figure 3-9 Frequency response measurements using a fixed level of -15 dBm

Suitable attenuators (i.e. from the point of view of frequency range) can be used to obtain levels less than -15 dBm.

Variable send levels:

The 75-Ω version of the SNA-1 can be expanded to give a complete sweep measuring setup, if the PSS-16 Level Generator (BN 873) is also used. The frequency range of the setup is 10 kHz to 160 MHz.

Figure 3-10 shows you how to set up this arrangement. The send level can be varied from -70 to +10 dBm. The smallest increment is 0.1 dB. The send level is shown on the PSS-16, the SEND LEVEL value shown on the SNA-1 is therefore irrelevant; cf Figure 3-11.

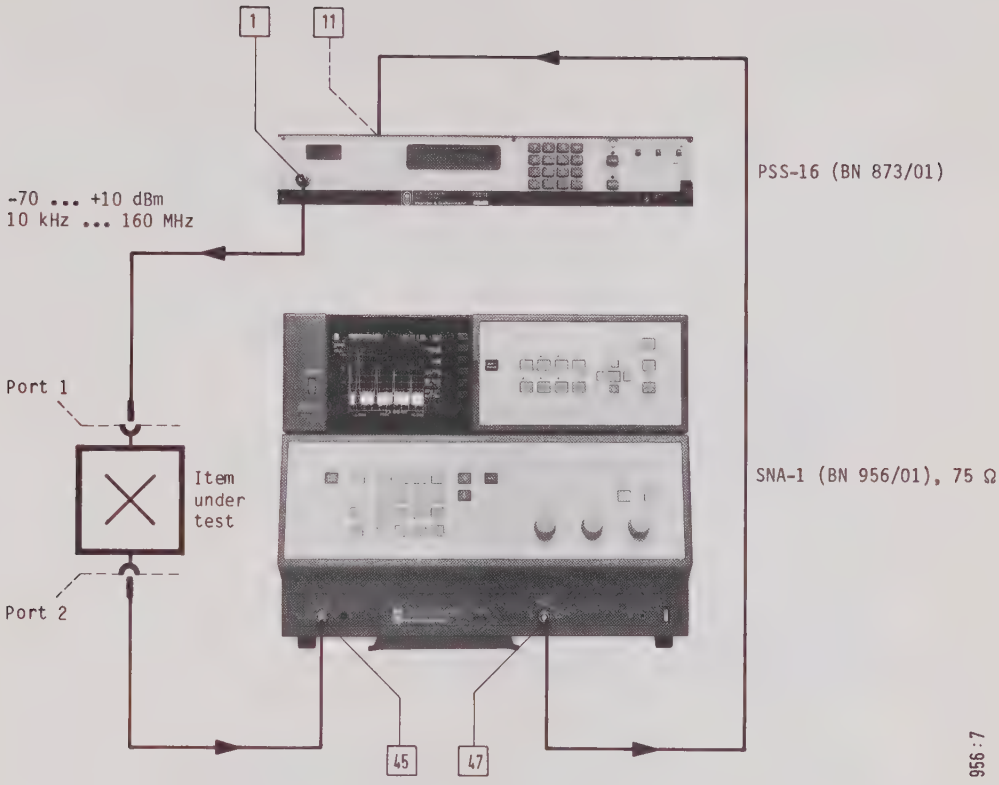


Figure 3-10 Frequency response measurements using the SNA-1 (variable send level)

3.7.2 NETWORK ANALYSIS TEST DISPLAY

Switch on the network analysis mode (frequency response measurements)

* Press MODE MENU [30]
* Press softkey (2)

The NETWORK ANALYSIS test display is shown on the screen, see Figure 3-11:

- The frequency response trace is shown using the calibrated internal graticule. The graticule has lettering as an aid for reading the results.
- The measurement parameters are shown, as are the values which were last set.
- The screen-memory which has been selected is shown, e.g. M

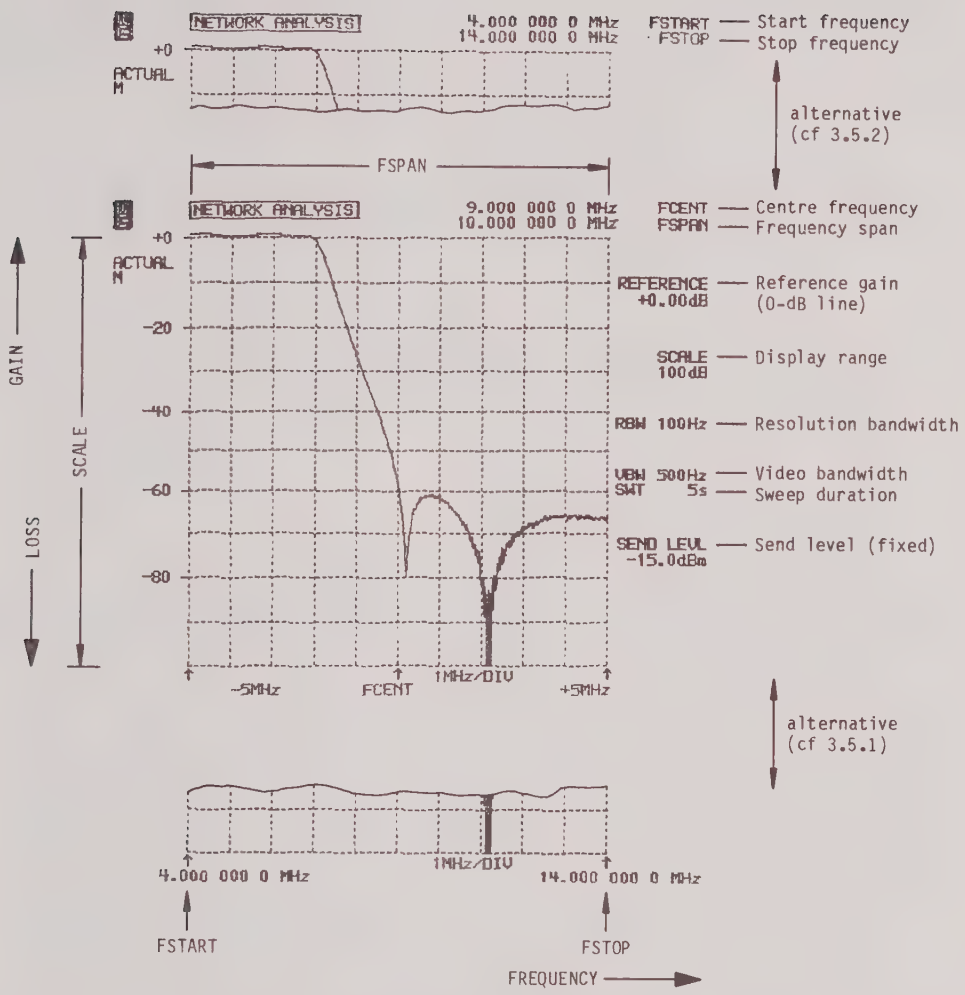


Figure 3-11 Spectrum analysis test-screen for frequency response measurements (alternative frequency-axis display)

3.7.3 SETTING THE PARAMETERS

With the exception of softkey (6), the measurement parameter list shown on the test-screen 3-11 is the same as the list shown in test-screen 3-6 (spectrum analysis). The send level (SEND LEVL) at the tracking generator output [47] is given instead of the input attenuation. (SNA-1 BN 956/01 has a fixed level of -15 dBm).

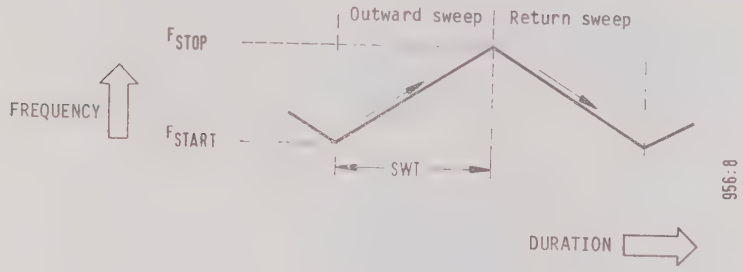
When you are carrying out network analysis the input attenuation is always automatically adjusted to its optimal value for the selected reference gain (REFERENCE).

The frequency span must always be borne in mind when selecting the parameters RBW, VBW and SWT for the item under test.

Set the parameters in the way described in 3.6.5 (spectrum analysis).

3.7.4 CHECKING THE SETTLING TIME

In contrast to the spectrum analysis mode, the outward and return sweep are used to form the trace on the screen: triangular sweep.



If the outward and the return sweep are not the same, the sweep duration SWT should be increased.

3.8 INTERNAL GRATICULE AND CALIBRATION

The traces A, M, A-M, and A&M (cf 3.9) are displayed on the electronically calibrated internal graticule (no parallax). The brightness of the graticule can be varied with control [1] so that the traces are easier to read

3.8.1 LEVEL SCALE

The level scale has 10 divisions. Whenever a range is selected (SCALE), the scale in dB is written on the screen automatically. The uppermost horizontal line, the 0 dB line, is equal to the REFERENCE value shown on the screen (cf Figure 3-6 and 3-11).

- Spectrum analysis

  REFERENCE = reference level (dBm or dB)

- Network analysis

  REFERENCE = reference gain (dB)

The absolute value of a point on the trace can be found in the following way:

Asolute value = REFERENCE value + scale value

The cursor is provided to help you determine the scale value, cf 3.11.1.

3.8.2 FREQUENCY SCALE

The vertical lines which form the linear divisions of the frequency scale are produced automatically; the size of the divisions depends on the values which have been selected for FSTART, FSTOP (FCENT, FSPAN). The SNA-1 sets up the frequency scale so that each line represents a whole number; the frequency difference between lines is shown numerically on the screen (kHz/div, MHz/div).

The vertical lines for the stop and start frequency FSTOP and FSTART, have their frequency values written next to them (arrow on frequency scale). For FCENT/FSPAN or FSTART/FSPAN, the frequency difference between each of these lines and FCENT or FSTART is shown.

3.8.3 RESOLUTION OF THE INTERNAL GRATICULE

	Maximum no. of pixels	Resolution (e.g. with the cursor)
Level scale (y)	250	SCALE-VALUE/250 (dB)
Frequency scale (x)	500	FSPAN-VALUE/500 (kHz, MHz)

3.8.4 SWITCHING THE INTERNAL GRATICULE ON OR OFF

If the cursor (cf 3.11) or a tolerance mask (cf 3.12) is use to evaluate the results, the internal graticule is not always of immediate use, it can therefore be switched off: (assume the test screen and internal graticule are shown)

* Press DSPLY PARAM [2] ● Display menu as per Figure 3-5
* Press GRATICULE softkey (2) ● GRATICULE ⟶ OFF
* Press RETURN softkey (6) ● Gives the originally selected test screen without internal graticule

3.8.5 AUTOMATIC CALIBRATION (AUTO CAL)

The SNA-1 has an automatic calibration facility which makes manual calibration superfluous. This facility ensures a high accuracy of measurement throughout the whole level and frequency range. The automatic calibration facility is switched off when the red LED under AUTO CAL [31] is on. This key is the on/off switch for the automatic calibration facility. Calibration is carried out at the centre frequency.

A calibration cycle is performed as follows:

- When the SNA-1 is switched on
- When the calibration facility is switched on with key [31]
- Automatically every three minutes
- Whenever a parameter that affects level accuracy is altered (e.g. RBW, centre frequency etc.)

When a calibration cycle occurs, the sweep is halted (see switching on AUTO CAL) until the cycle is over. The sweep the continues where it left off.

3.9 TRACE DISPLAY (DISPLAY [3])

3.9.1 MEMORY A

The measurement result is continuously stored in memory A, and immediately shown on the screen (dynamic display).

* Use key row [7] to select the measurement result
* Press A (LED on) ● Display: ACTUAL A

For each frequency point x (total 500). Two level values are stored in memory A.

y_{min}, minimal level in time window SWT/500[1)]
Y_{max}, maximal level in time window SWT/500[1)]

1) Value range: $0 \leq y_{min} \leq Y_{max}$; $y_{min} \leq y_{max} \leq 250$.
The points y_{min}, y_{max} are joined together on the screen (vertical line segment).

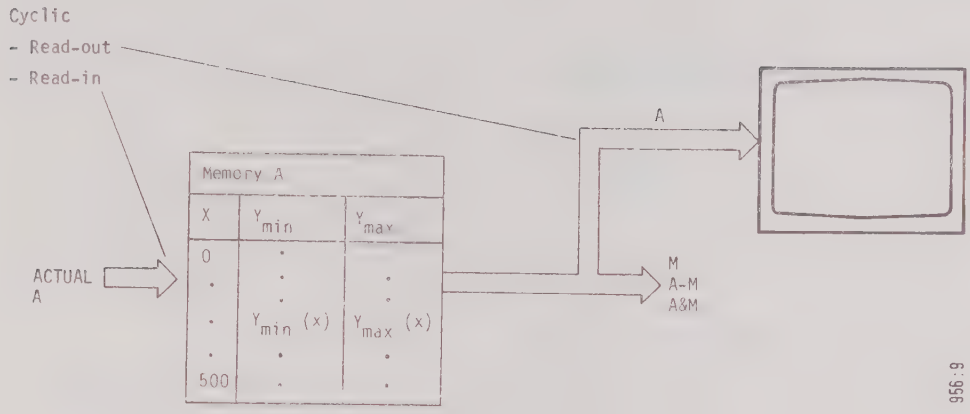


Figure 3-12 Organisation of memory A

For sweep times longer than 1 s, a frequency marker "X" can be seen on the screen. The frequency marker shows the current test point.

3.9.2 BACKGROUND MEMORY M

The contents of memory A can be transferred to memory M and called up any time at a later date. The contents of this memory are not lost when the SNA-1 is switched off.

Store (A ⟶ M), key A is on (LED on)

* Press keys A and M simultaneoulsy

Calling up M

* Press M (LED on) ● Display: ACTUAL M

3.9.3 DIFFERENCE TRACE A-M (NORMALIZER FACILITY)

A facility for displaying:

current trace (memory A) - stored trace (memory M)

is of great practical value for frequency response measurements.

If the intrinsic frequency response of the SNA-1 is stored in M before the two-port measurement is carried out, the intrinsic error is almost eliminated by switching to A-M mode when the item under test has been connected (normaliser). The scale used for the M trace must be the same. The 0 dB marker is automatically positioned on the central horizontal line. If you want, it can be positioned on another horizontal line, by pressing the SCALE softkey (3) and then shifting it with the STEP keys [33] (REF. POS.).

- Determine the frequency and level range
- Store intrinsic frequency response

  * Short-circuit output [47] and input [45]
  * Switch ACTUAL A and A on (LEDs on) ● Display: ACTUAL A
  * Press A and M simultaneously

- Measuring the frequency response of a two-port network

  * Connect two-port network
  * Press A-M (LED on) ● Display ACTUAL A-M

3.9.4 DISPLAYING THE CURRENT TRACE AND THE REFERENCE TRACE A&M

To carry out comparative measurements, one must be able to display two traces simultaneoulsy.

- Set the frequency range and the level range
- Store the frequency response of 1st item under test (A→M)
- Display the frequency response of 2nd item under test as the current trace.
- Simultaneous display of both traces:

  * Press A&M (LED on) ● Display: ACTUAL A&M
  * If need be, shift the current trace vertically by changing the REFERENCE value

The lettering on the screen and the scales refer to trace A.

3.10 THE CURRENT TRACE AND ITS DIGITAL CONDITIONING (key row [7])

3.10.1 CURRENT RESULT (ACTUAL A)

Normal operation: switch ACTUAL A on (LED on).

After analog/digital conversion, the test signal is read into the screen store cyclically in synchronism with the sweep. After each sweep, the complete memory contents are up-dated. (If A has been pressed (normal operation), the memory contents are shown immediately).

3.10.2 DETERMINING THE PEAK-VALUE (MAX A)

If you want to record the maximum level values that occur over a period of observation (>>SWT), use the maximum-hold function. This function is ideal for measuring the level and frequency drift of spectral lines, and also for detecting spurious signals of a continuous or random nature (long-term monitoring).

Switch-on

* Press MAX A [7] (LED on)
* Press A (LED on)

Switch-off

* Press ACTUAL A [7]

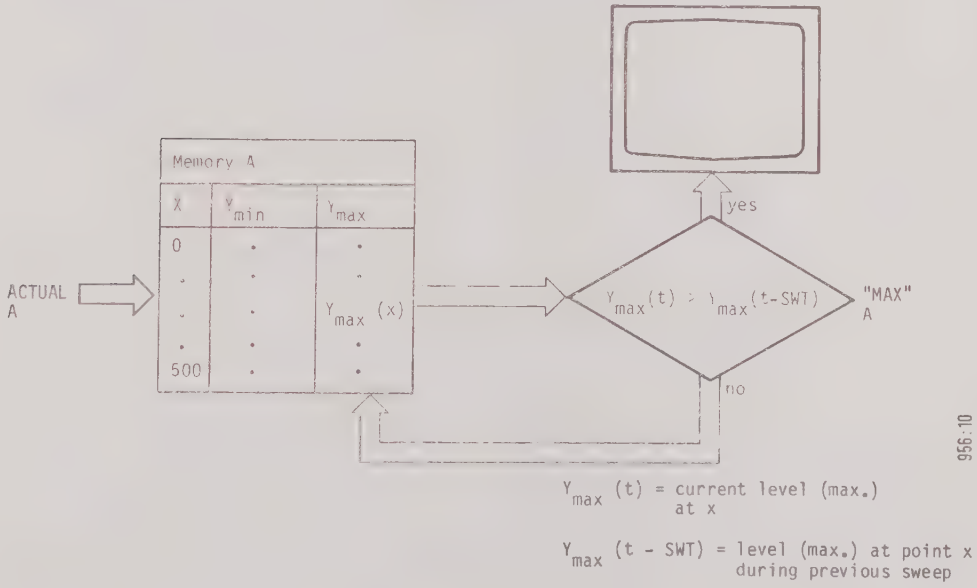


Figure 3-13 Operation of the MAX-HOLD function

If SWT > 1 s, the marker "X" shows the current test point

3.10.3 NOISE AVERAGING (AVRG A)

The averaging function can be used to smooth noisy traces, or sections of traces that are noisy. This makes it easier to carry out measurements on the trace, e.g. measuring the noise bandwidth with the level cursor (cf 3.11.1).

Averaging is carried out after each sweep, and so the effect is cumulative.

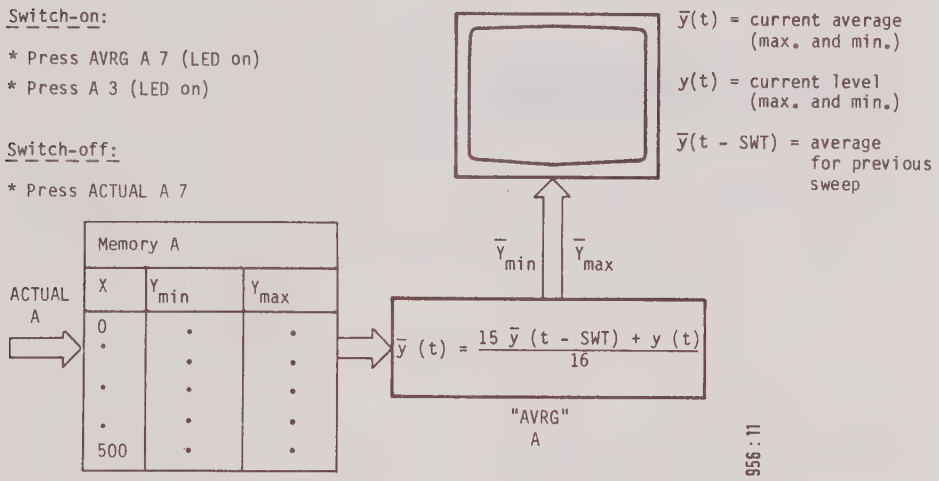


Figure 3-14 Operation of the averaging function

Example: Using the averaging facility spectral lines having levels of the same order of magnitude as the noise level can be resolved. Figure 3-15a shows the signal without noise averaging, Figure 3-15b shows the signal with noise averaging.

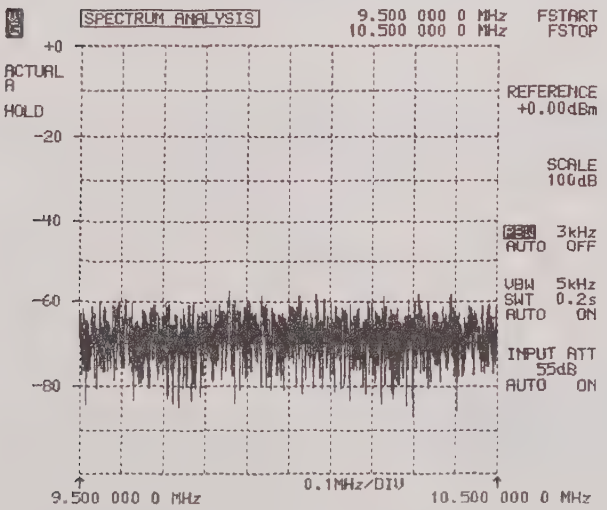


Figure 3-15a Noisy signal before averaging

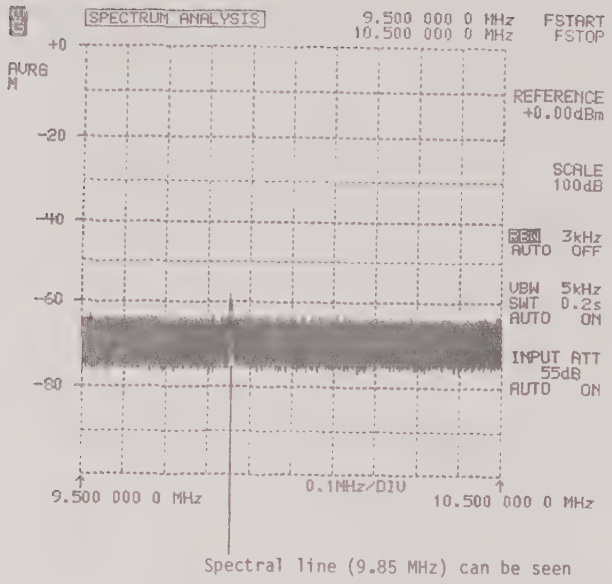


Figure 3-15b Noisy signal after averaging

The averaged trace (cf Figure 3-15b) appears as a noise band because the maximum and minimum level values (y_{max}, y_{min}) are determined separately.

3.10.4 FREEZING THE TRACE (HOLD A)

Everything shown on the screen can be "frozen":

* Press HOLD A [7]

It is a good idea to freeze the screen contents before making a record of the results with a video-plotter, a graphics plotter or a camera. After you have made your recording, the sweep can be continued by pressing ACUTAL A.

3.10.5 ERASING THE TRACE (RESTART)

If you want to re-record the results during a measurement (e.g. if SWT >> 1 s), the measurement procedure can be started again by pressing ACTUAL A [7] (or MAX A, AVRG A). The original trace on the screen is erased.

3.11 C U R S O R S

3.11.1 ABSOLUTE CURSOR

Spectrum measurements or frequency response measurements are carried out with the aid of cursors:

- Level cursor (horizontal line), moved with " ⇧ " or " ⇩ " [4]
- Frequency cursor (vertical line), moved with " ⇦ " or " ⇨ " [4]

When a frequency or level cursor is shifted to a particular position on the screen, the frequency and level values at this point are shown numerically on the screen (absolute values, cf Figure 3-16).

The cursors have the following resolutions:

- Level cursor: $\frac{\text{SCALE}}{250}$
- Frequency cursor: $\frac{\text{FSPAN}}{500}$

The cursors can be shifted to any position on the internal graticule using the arrowed keys [4].

Setting:

- Level cursor: Press ⇩ : cursor appears at the top of the screen and can be moved downwards
  Press ⇧ : cursor appears at the bottom of the screen and can be moved upwards
- Frequency cursor: Press ⇨ : cursor appears at the left of the screen and can be moved to the right
  Press ⇦ : cursor appears at the right of the screen and can be moved to the left

To move cursor faster, press an arrowed key and the FAST key.

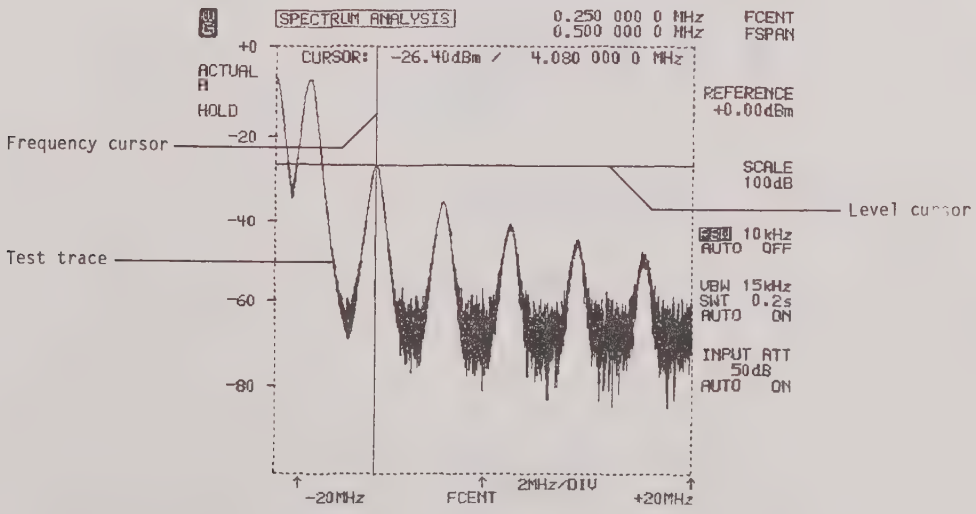


Figure 3-16 Cursor lines for determining the level and frequency of a point on the measurement trace (graticule off, cf 3.8.4)

3.11.2 RELATIVE CURSOR

If you want to know the frequency difference and level difference between two points on the trace, it is a good idea to use the relative cursor. After you have placed the absolute cursor (1st line pair) on the first trace-point (cf 3-16), place the relative cursor (2nd line pair) on the second trace point (cf Figure 3-17).

A number pair displayed on the screen

REL: ⌊____⌋dB/⌊____⌋ MHz

gives the level and frequency difference between the two points.

Setting:

* Set the absolute cursor to the 1st point on the trace using the arrowed keys [4]
* Press REL CURSOR [6]
* Using the arrowed keys " ⇧ " or " ⇩ " [4], set the relative-level cursor to the required position
* Using the arrowed keys " ⇦ " or " ⇨ " set the relative-frequency cursor to the required position.

To distinguish the cursors (absolute/relative) the intersection of the absolute cursor is marked with a circle.

Switching off the absolute cursor:

* Press REL CURSOR [6]

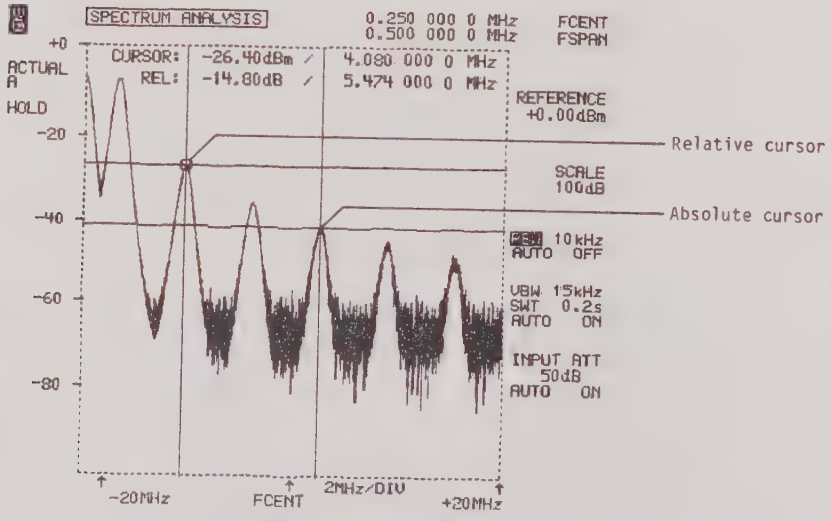


Figure 3-17 Relative cursor for measuring the level difference and frequency difference between two points

3.11.3 CURSOR TRANSFER

Using the cursor transfer facility, the value indicated by the frequency cursor can be used as the new start, stop or centre frequency. Any value indicated by the level cursor can be used as the new reference level (0 dB line).

The measurement parameter to be updated is selected via softkey. When you are carrying out a frequency cursor transfer, it may be necessary to preselect various parameters via the display menu (cf 3.5.2). In this way, you can bring a trace into any region of the screen you want, simply and easily.

Example: You want to display the right-hand side of the attenuation curve shown in Figure 3-18a from the pole.

There are two possibilities: Set the cursor and use the frequency value it indicates as the new start or the centre frequency.

* Set the frequency cursor to the pole using " ⇦ " [4] (or " ⇨ ").
* Press softkey (1) FCENT (reverse video)
* Press the transfer cursor key CURSOR ⟶ [8] (the cursor value is used as the new centre frequency, cf Figure 3-18b).
* Press the key CURSOR ⟶ [8] several times to increase the frequency range (FSPAN remains constant).

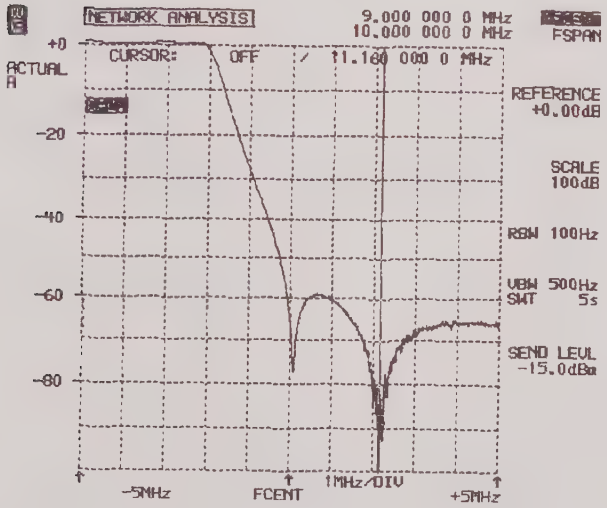


Figure 3-18a Result of using the cursor-transfer cursor to increase the display range to the required value (⟶ new centre frequency)

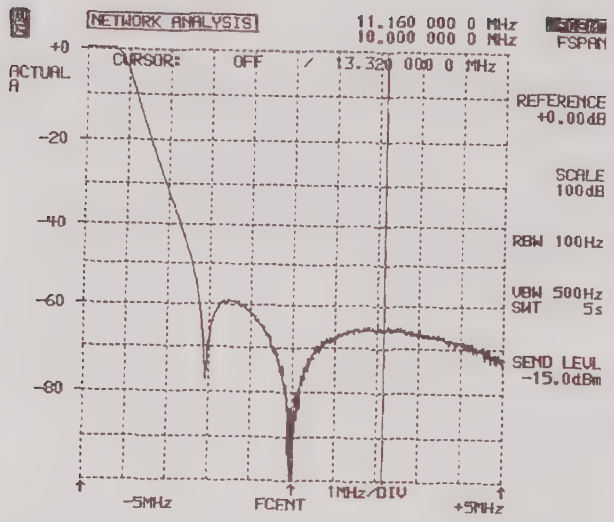


Figure 3-18b Result of using the cursor-transfer cursor to change the display range

3.12 TOLERANCE MASKS

3.12.1 GENERAL INFORMATION

With tolerance masks it is easy to tell if a trace lies within the required level limits. With the SNA-1 you can display and store two different tolerance boundaries (M1 and M2). These tolerance boundaries are composed of several line segments, whose gradients may take on any value. Figure 3-19 shows a tolerance mask formed from 10 points

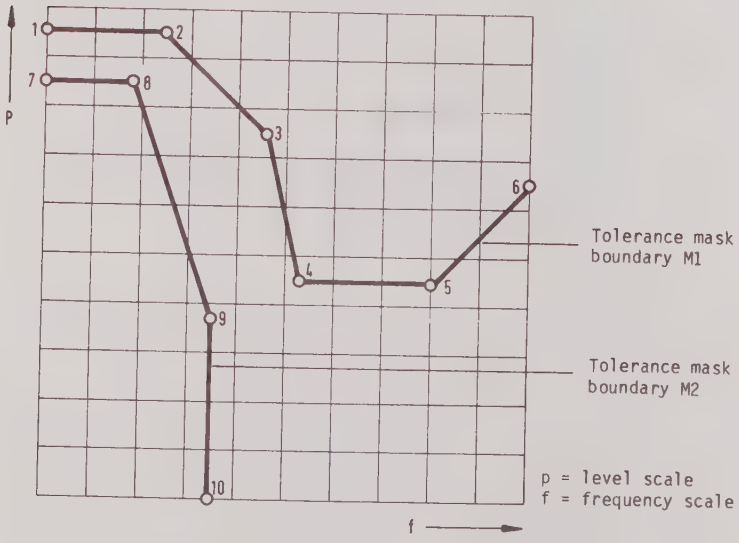


Figure 3-19 Tolerance mask comprising the tolerance boundaries M1 and M2
M1 is made up of the points (P_i/f_i) i = 1 6
M2 is made up ot the points (P_i/f_i) i = 7 10

3.12.2 PROGRAMMING A TOLERANCE MASK

By calling up "tolerance mask programming" via the display menu (cf 3.5), the defining points (P_i/f_i) of the tolerance mask can entered by storing several cursor intersections (level cursor/frequency cursor):

* Press DISPLY PARAM [2]
* Press softkey (4) PROGRAM TOL MASK ● Menu display 3-20 is shown

Entering the tolerance mask boundaries M1, M2

* Define the first point on the mask with the cursor (cf 3.11.1)
* Press softkey (2) CURSOR → M1 ● 1st point is stored
* Set the second point with the cursor
* Press softkey (2) CURSOR → M1 ● 2nd point is stored, line joining the points is shown on screen
* Continue to set up the tolerance mask boundary M1 in a similar manner

If softkey (3) CURSOR → M2 is pressed, the point marked by the two intersecting cursors is included in tolerance mask boundary M2.

Displaying the tolerance mask/removing it from the screen

* A tolerance mask that has already been programmed can be displayed on the screen or removed from the screen, when softkey (3), as shown in Figure 3-5 (display menu), is pressed (on/off function).

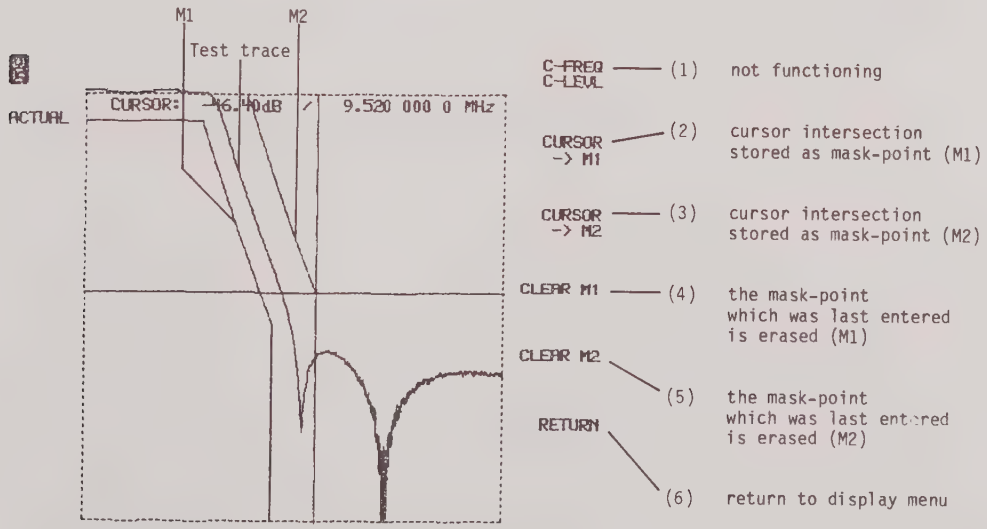


Figure 3-20 Tolerance mask programming menu-display

Erasing the tolerance mask

* The last point entered is erased when you press softkey CLEAR M1 (M2) (4) or (5)

In Figure 3-20 CLEAR M2 has been pressed; the line and point are removed from boundary M2.

* Each time CLEAR M1 (M2) is pressed, a point in the tolerance mask boundary is removed. When a bleeping tone is output, the point that was entered first has been erased.

3.13 LISTING THE SNA-1's DISPLAY

3.13.1 VIDEO PRINTER

The video signal from the SNA-1 is output at connector S on the back panel, the signal can then be fed via a BNC cable to a video-printer. The video-printer must be capable of reproducing composite video signals (Standard B).

It is a good idea to freeze the display before outputting it on the printer (HOLD A).

An external monitor can be connected to connector S (e.g. to get a bigger display).

3.13.2 GRAPHICS PLOTTER

The IEC/IEEE connector can be used for a graphics plotter, e.g. Hewlett Packard 7470, 7475. The SNA-1 must be fitted with the IEC bus board (BN 958/01, option).

IEC/IEEE interface settings

SNA-1 (cf 4.2.1)	Graphics plotter
Any address (0 .... 28)	Address: 29
System control: on	

The plotter can be controlled by the SNA-1 when the PLOTTER CONTROL menu has been called up (i.e. via the display menu, see 3.5):

* Press DISPLY PARAM [2]
* Press softkey (5) PLOTTER CONTROL

Graphics plotter initialisation:

* Press RESET softkey (1)

Plot required screen contents

* The plotting procedure is controlled using the softkeys (2) to (4) (cf softkey functions in Figure 3-21)

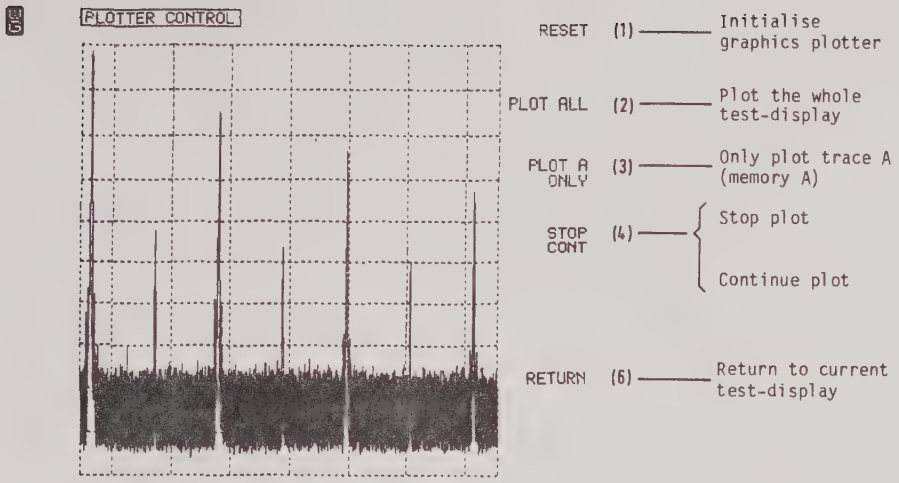

PLOTTER CONTROL
RESET (1) Initialise graphics plotter
PLOT ALL (2) Plot the whole test-display
PLOT A ONLY (3) Only plot trace A (memory A)
STOP CONT (4) Stop plot
Continue plot
RETURN (6) Return to current test-display

Figure 3-21 Menu display for plotter control

Abbreviated Operating Manual for Transmission System Analyzer TSA-1, BN 956/03

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4. Automatic calibration . . . . . page 1
5. The concept of operation . . . . . page 2
6. Setting the measuring parameters . . . . . pages 2 to 5
7. VDU display . . . . . page 5
8. Storing of instrument set-ups . . . . . page 5
9. Special functions with spectrum analysis . . . . . page 6

1. Commissioning

- Assembly: place display section on analyzer section and attach together by the four fast action fasteners (rotate screwdriver slots in counter-clockwise direction and position with slots horizontal. This is particularly important for transportation).
- Connections to the TSA-1 back panel:
  220 to 400 MHz, carrier frequency; cable K 336 between connectors [52] and [58].
  400 kHz IF; 2 each cable K 197 between [53] and [60] and [54] and [61].
  Data and address bus; cable K 416 between [50] and [55].
  A.C. power cable from analyzer section to display section.
- Switch on: Caution! a.c. line voltage selector switch on display section must be set to the rated a.c. line voltage. Change fuse also. Connect a.c. power cord of analyzer section to 50/60 Hz a.c. power line. Switch on TSA-1. It is immediately ready for operation. But the full measuring accuracy is reached after 15 min. of operating time. If the TSA-1 is taken out of storage at an ambient temperature different than that for operation, a settling time must be taken into account.

2. Basic set-up

- After switch-on, a selftest takes place. Thereafter the last selected setting is effective.
- The "MODE MENU" key is depressed to call-up the mode menu. Immediately after selection of a mode, the measuring trace is displayed with all of the last selected instrument parameters.
- The basic set-up is recalled by depression of keys "RCL 0-9" and "0". The mode menu is displayed. After the mode has been selected, the measuring trace is displayed for the defined set-up; e.g. with SPECTRUM ANALYSIS:
  frequency range, 0 to 180 MHz; reference, 0 dBm; display range, 100 dB; all automatic functions switched in; and the current A curve.
  Instrument set-ups with tolerance masks and the M curve remain stored.
- For a reset the "CLR" key should be held depressed until a beep tone is emitted at the time the TSA-1 is being switched on. Then the basic set-up is implemented. In addition, instrument set-ups with tolerance masks and the M curve are cleared.

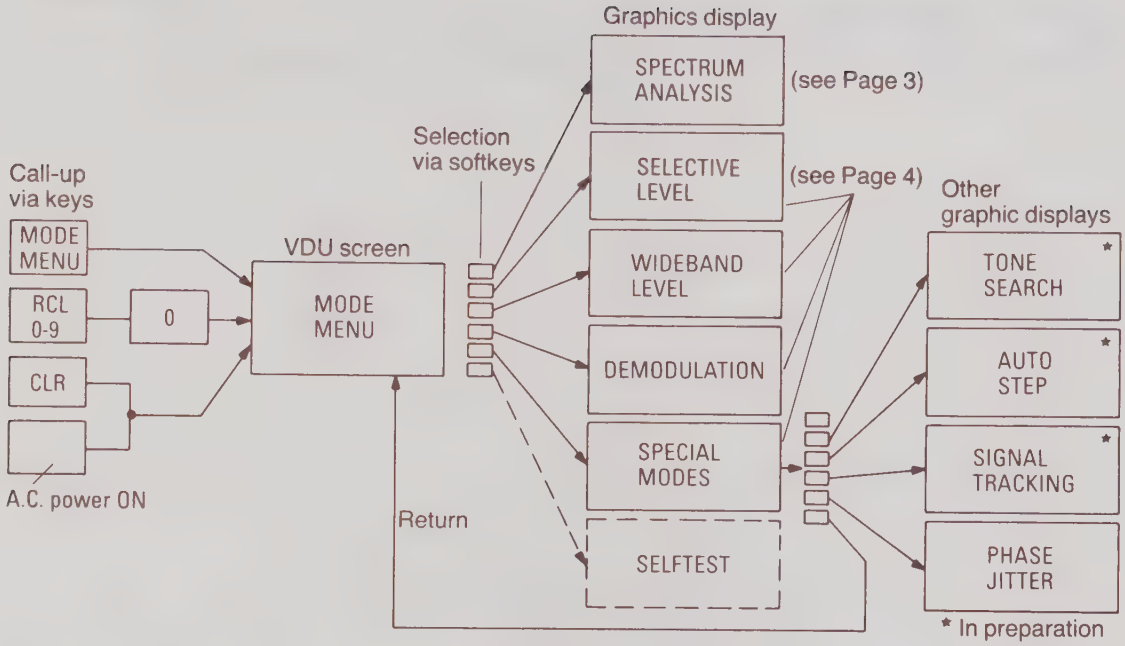
3. Connections for measuring

Input: maximum tolerated level +20 dBm (+10 dB) or 100 mW (AC- and DC-component).
Tracking-generator output: level, −15 dBm; frequency range, 10 kHz to 180 MHz.

4. Automatic calibration

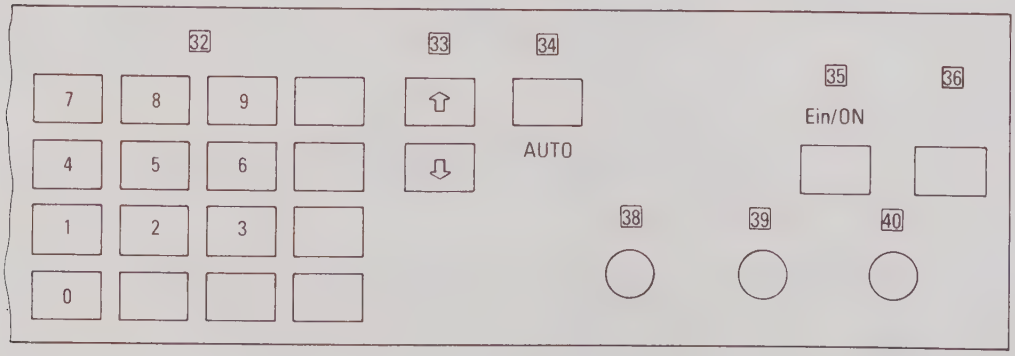
"CAL" is displayed on the VDU. Switch off with AUTO CAL key [31], red LED lights.

5. The concept of operation
Mode menu



The graphics display shows the setting parameters. After selection via the coordinated soft key the inverse video displayed parameter is adjustable via the numerical keypad [32] or the step key [33]. The three knobs [38], [39], and [40] are functional direct without preselection via the soft keys.

6. Setting the measuring parameters
6.1 Digital and analog entry as well as stepwise changes



6.2 Spectrum analysis
This mode is also suitable for swept frequency measurements

VDU screen	Parameter (soft key function)	Set-up with	
FSTART FSTOP	Starting frequency, FSTART [1]	32	0.1 Hz resolution
	Stopping frequency, FSTOP [1]	32	0.1 Hz resolution
or FSTART FSPAN	Starting frequency, FSTART [1]	32 40	0.1 Hz resolution quasi-continuous, 35 at ON
	Frequency span, FSPAN	32 33 39	0.1 Hz resolution } 1-2-5 steps
or FCENT FSPAN	Center frequency, FCENT [1]	32 40	0.1 Hz resolution quasi-continuous, 35 at ON
	Frequency span, FSPAN	32 33 39	0.1 Hz resolution } 1-2-5 steps
REFERENCE −30.00 dBm	Reference level [1] (0 dB reference trace)	32 33 38	0.01 dB resolution } 1 graticule division/step
SCALE 100 dB	Display range (10 divisions of vertical axis)	33	1-2.5-5 steps from 1 to 100 dB
RBW 3 kHz AUTO ON	**R**ESOLUTION **B**AND**W**IDTH	33	1-3 steps from 3 Hz to 30 kHz
	Automatic ON/OFF	34	Coupling to frequency span
VBW 5 kHz SWT 1 s AUTO ON	**V**IDEO **B**AND**W**IDTH	33	5-15 steps from 5 Hz to 50 kHz, 150 kHz
	SWEEP TIME [2]	33	In 1-2-5 steps from 200 ms to 20 h
	Automatic ON/OFF	34	Coupling to RBW
INPUT ATT 35 dB AUTO ON	Input attenuation	33	In 5-dB-steps from 0 to 65 dB
	Automatic ON/OFF	34	Coupling to RBW and REFERENCE

1) Setting possible also through Cursor Transfer (see 9.3)
2) Manual frequency tuning with knob 40, key 36 at ON

6.3 Level measurements

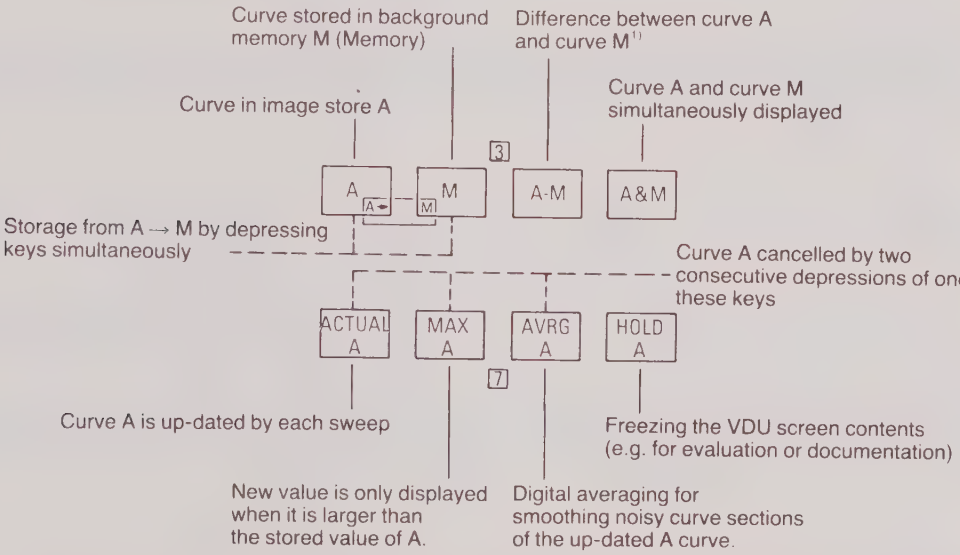
VDU screen	Parameter (soft key function)	Set-up with	
SELECTIVE FREQ FSTEP	Tuning frequency (entry check; current value displayed in "TUNE FREQ" field)	[32] [40] [33]	0.1 Hz resolution quasi-continuous, [36] at ON in steps according to FSTEP
	Frequency step for stepping mode	[32]	0.1 Hz resolution
SCALE REF 0.00 dBm AUTO ON	Reference value for 0 dB scale display [1]	[32] [33] [38]	0.01 dB resolution } one tenth full scale/step
	Automatic ON/OFF	[34]	Coupling to input level
SCALE 100 dB	Display scale for quasi-analog bar-graph display	[33]	1-2.5-5 steps of 1 dB to 100 dB
BANDWIDTH 3.1 kHz	Resolution bandwidth	[33]	10 Hz, 30 Hz, 300 Hz, 3.1 kHz, 48 kHz
TUNE RES COARSE	Resolution of the quasi-continuous frequency tuning with knob [40]	[33]	FINE: 1 Hz COARSE: 100 Hz
AFC ON [OFF]	Automatic frequency control ON/OFF (in preparation)	–	Capture range corresponds to resolution bandwidth; switching by soft key
DEMOD-ULATION CHANNEL USB WTG FLAT	Channel position for single sideband demodulation (tuning to carrier)	[33]	**U**PPER **S**IDE**B**AND **L**OWER **S**IDE**B**AND
	Noise **W**EIGH**T**I**NG**	[33]	FLAT psophometric weighting
VOLUME (STEP ENTRY)	Volume control for built-in loudspeaker	[33]	↑ Louder ↓ Softer
SPEAKER ON [OFF]	Loudspeaker ON/OFF	–	Switching by soft key
PHASE JITTER BANDWIDTH 4 - 20 Hz	Bandwidth for jitter evaluation according to CCITT O.91 or IEEE 743 (BN 956/05)	[33]	LOW FREQUENCY (LF): 4 to 20 Hz STANDARD (STD): 20 to 300 Hz Total (LF + STD): 4 to 300 Hz

1) Level display in dBm, dB, dBmO, dBO or dBµV. Changeover by step key [33] after "DSPLY PARAM" [2] has been depressed and preselected with a softkey.

6.4 Display parameter menu (only with Spectrum Analysis mode)
After the "DSPLY PARAM" key [2] has been depressed the following parameters may be altered:
- frequency scale with center frequency/span or starting frequency/span or Starting/Stopping frequency
- level display in dBm, dB, or dBμV (Selection with "STEP" key [33])
- frequency and amplitude graticule switching on or off
- tolerance mask switching on or off
- tolerance mask programming (see Section 9.4)
- graphics plotter controlling (via IEC/IEEE interface)

Return to measuring trace via soft key "RETURN" or "DSPLY PARAM" key [2].

7. VDU display
7.1 Spectral presentation


Curve stored in background memory M (Memory)
Difference between curve A and curve M 1)
Curve in image store A
Curve A and curve M simultaneously displayed
3
A
A→M
M
M→A
A-M
A&M
Storage from A → M by depressing keys simultaneously
Curve A cancelled by two consecutive depressions of one of these keys
ACTUAL A
MAX A
AVRG A
HOLD A
7
Curve A is up-dated by each sweep
Freezing the VDU screen contents (e.g. for evaluation or documentation)
New value is only displayed when it is larger than the stored value of A.
Digital averaging for smoothing noisy curve sections of the up-dated A curve.

1) After the soft key "SCALE" has been depressed, the VDU screen displays "REF POS" in inverse video. Now the 0 dB reference trace can be shifted vertically via the "STEP" key [33].

7.2 Level display
Key [3] and [7] functions are also equivalent for the level display.
A: updated measured value at the set-up tuning frequency.
M: stored measured value. Entry via numeric keypad [32] ("M" key is switched in) or by storage from A → M.
A - M: level difference

8. Set-ups (MEMORY [37])
Instrument set-ups, including tolerance masks, can be stored under numbers 1 to 9 and can again be called -up later.
These set-ups are not cancelled when the instrument is switched off (exception: reset instrument by switching on a.c. power and simultaneously depress the "CLR" key).
Store: key "STO 1-9" and corresponding numerical key
Call-up: key "RCL 0-9" and corresponding numerical key
Basic setting (see Section 2): keys "RCL 0-9" and "0".

9. Special functions with spectrum analysis

9.1 Automatic settings

- Bandwidth, sweep: Switch off the automatic setting of RBW or VBW and SWT with "AUTO" key [34] or by altering parameter with "STEP" key [33].
  When reducing the bandwidth, observe that the current curve settles correctly, but if it doesn't, increase the sweep time SWT.
- Input attenuation: The automatic setting (best compromise between "low noise" and "low distortion" measurement) of INPUT ATT is switched off by "AUTO" key [34] or through varying the attenuation by "STEP" key [33].
  When the attenuation is reduced (low noise measurement) observe the intrinsic noise signal. The low noise setting is also suited to swept frequency measurements when the internal tracking generator is used.

9.2 OUT OF RANGE

If the tolerable measuring range for the set-up bandwidth RBW and input attenuation INPUT ATT is exceeded (REFERENCE and SCALE) the VDU displays "OUT OF RANGE" (erroneous setting). In addition, those parameters identified by an asterisk(*) must be altered, so that an error-free setting is arrived at.

9.3 Cursor functions

Horizontal and vertical measuring traces for exact determination of level and frequency values. Shifting with arrow key [4]; fast shifting by simultaneous depression of "FAST" key. For switching cursor out of display, just shift it off the screen.

- Cursor values: Absolute values are displayed when the "REL CURSOR" key [6] is in OFF position. After the "REL CURSOR" function has been switched in, a second pair of cursors aid in determining the relative values (difference, separation) referred to the first pair. The graphics display then shows the absolute and relative values.
- Cursor transfer: Transferring cursor values (absolute value) as new settings by depression of "TRANSFER" key [8]. The transfer is possible for FCENT, FSTART, FSTOP, or REFERENCE. The wanted parameter is selected via the soft keys (inverse video display).

9.4 Tolerance masks

Programming of a tolerance mask:

- depress "DSPLY PARAM" key [2]
- depress soft key "PROGRAM TOL-MASK"
  If a mask has already been stored; it is cancelled segmentwise by depression of the soft keys "CLEAR M 1" and "CLEAR M 2" until the beep-tone is heard.
- place "REL CURSOR" key [6] in OFF position
- establish first mask point of M 1 mask (intersection point) by using level and frequency cursors
- depress soft key "CURSOR → M 1" (storing of mask point)
- establish next mask point and again depress soft key "CURSOR → M 1":
  the two points are joined by a straight line. An erroneously entered segment is cancelled by use of soft key "CLEAR M 1".
  Thirty points are storable for each of the two curves, M 1 and M 2.
- after the mask has been assembled, the key "DSPLY PARAM" should be depressed (menu off).

Nine tolerance masks along with their related instrument set-ups may be stored (see Section 8).

DISPLAYS OF MENUS AND MODES

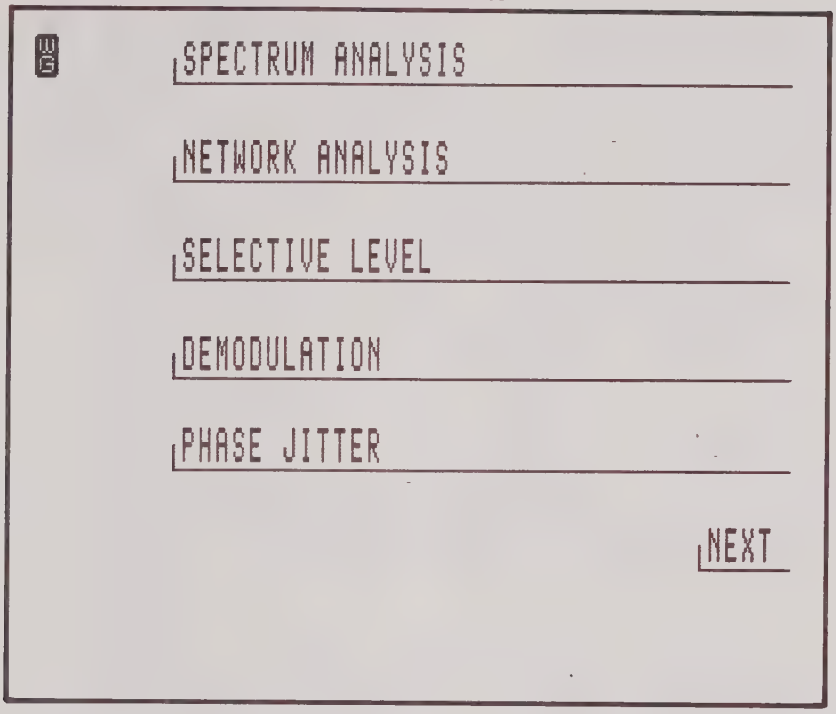


Figure 1 Operating mode menu display

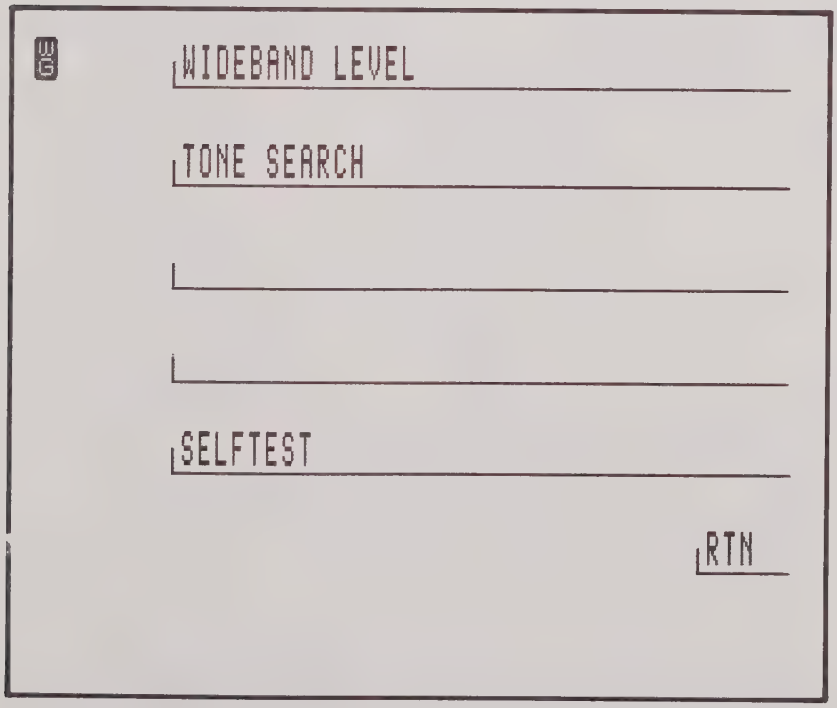


Figure 2 Operating mode menu display

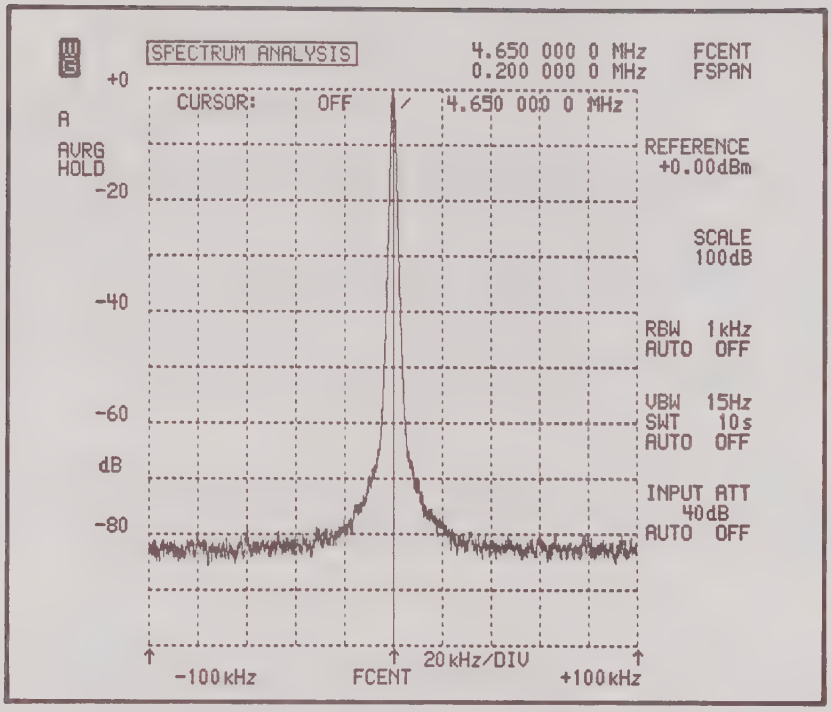


Figure 3 Spectrum analysis mode display

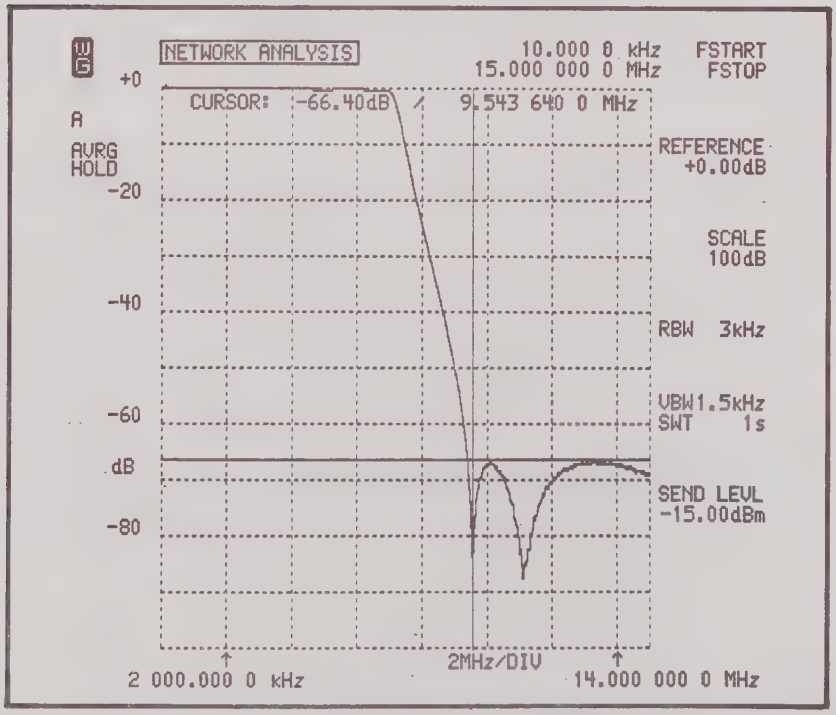


Figure 4 Network analysis mode display

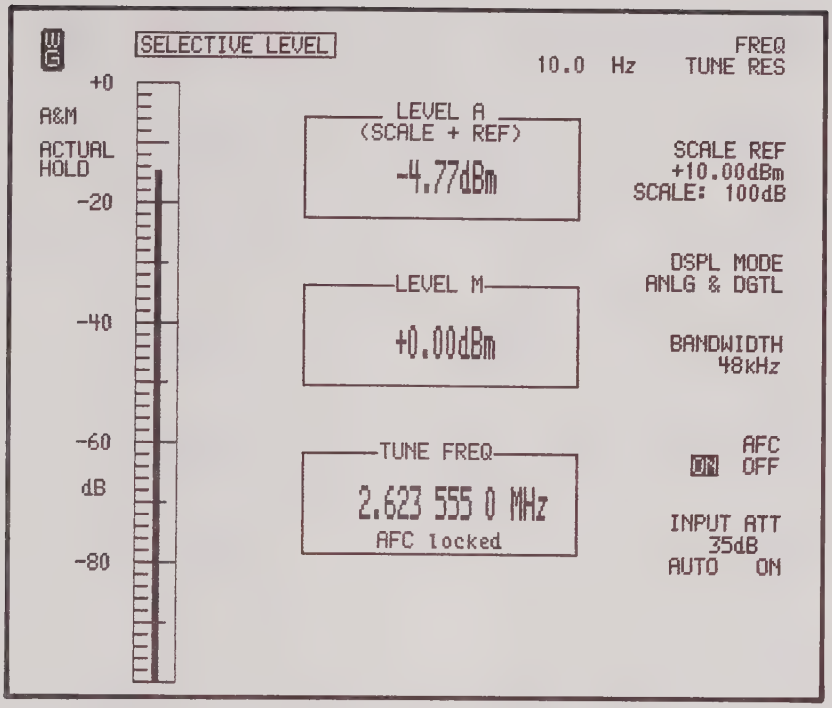


Figure 5 Selective level mode display

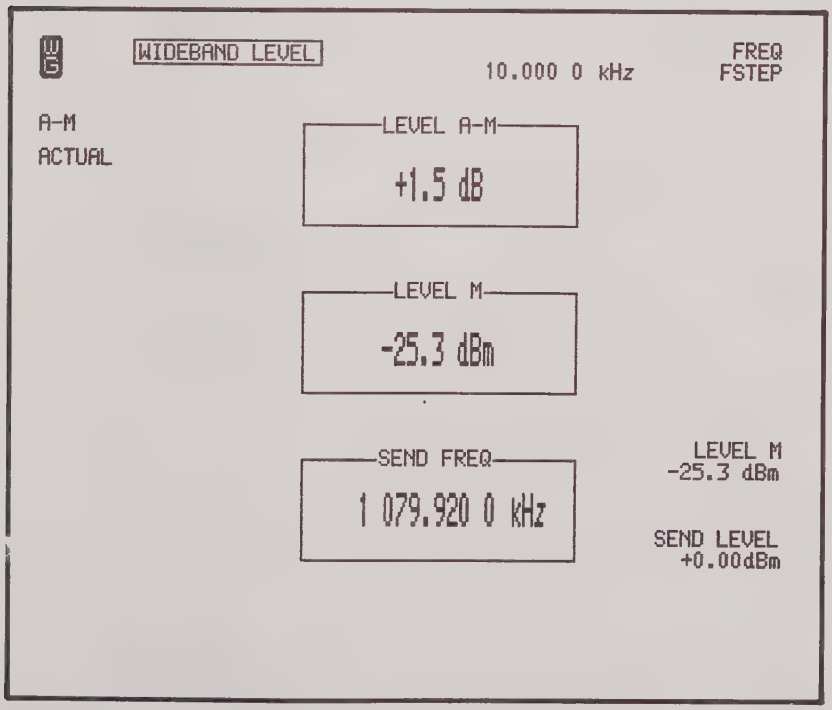


Figure 6 Wideband level mode display

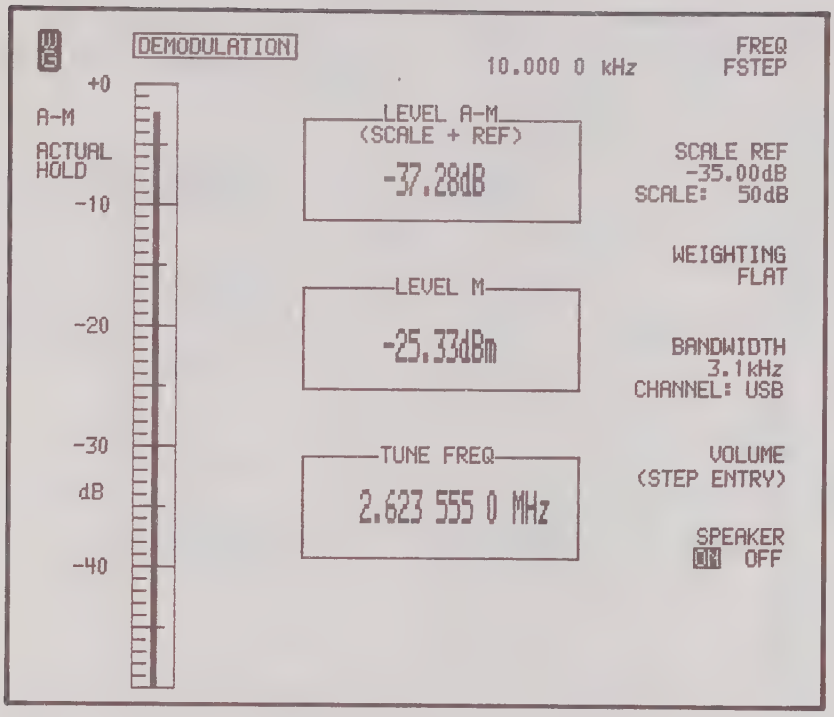


Figure 7 Demodulation mode display

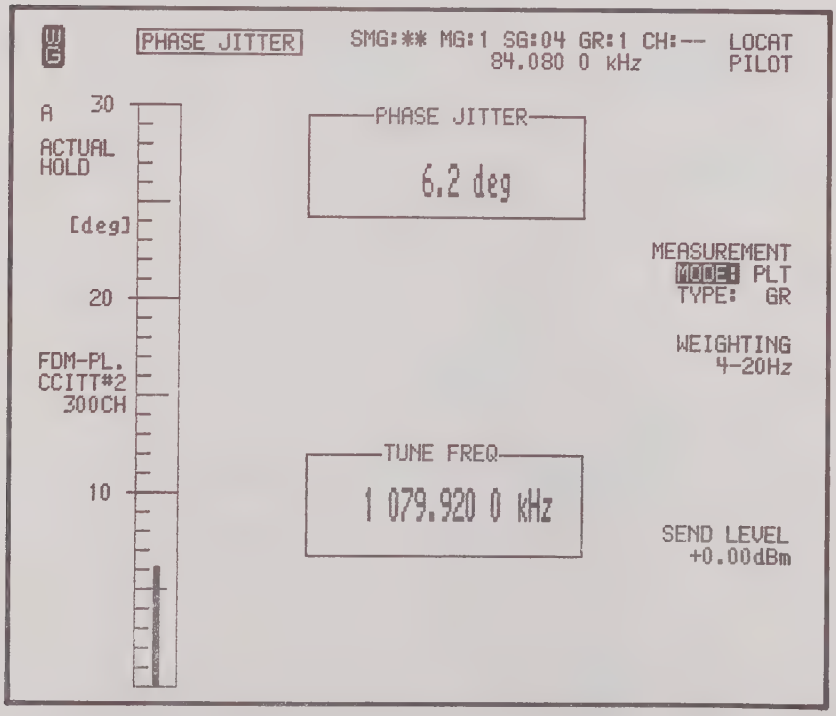


Figure 8 Phase jitter mode display

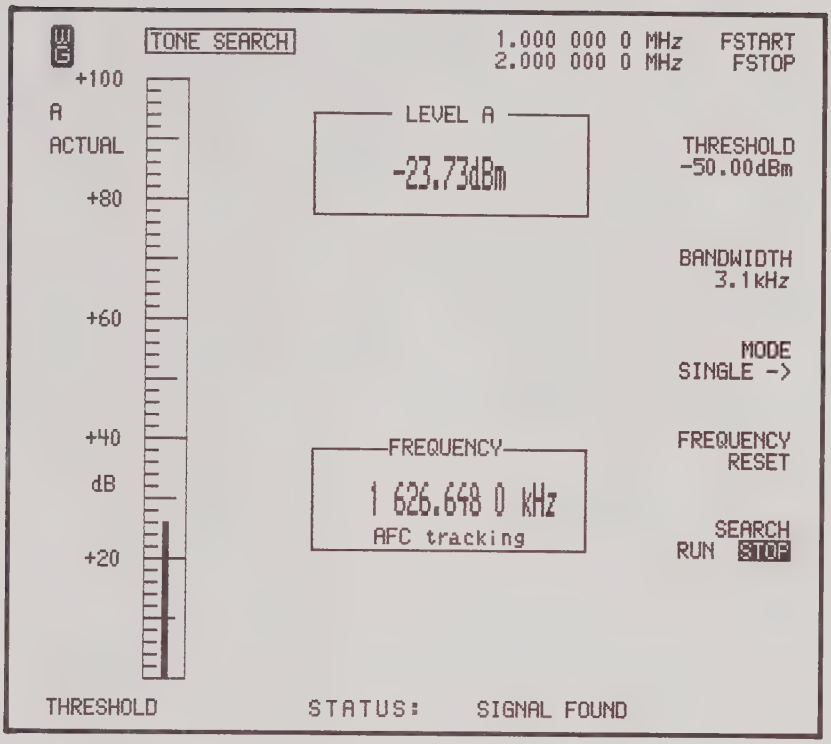


Figure 9 Tone search mode display

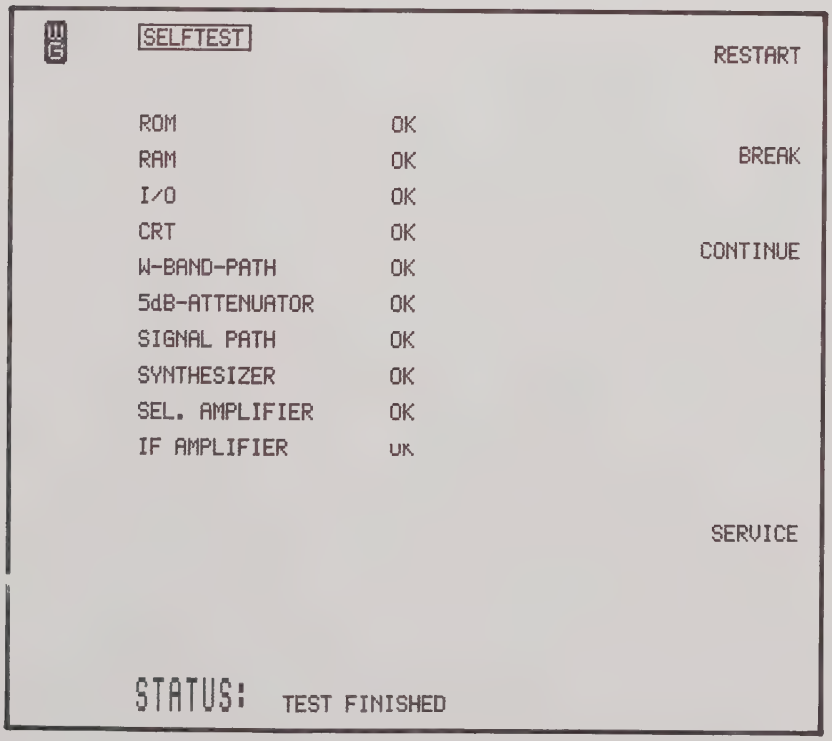


Figure 10 Selftest mode display

5 TSA-2 WITH FDM FREQUENCY PLANS

FDM-Mode, preferred frequencies to CCITT or INTELSAT plans

FDM systems are built up from a fixed number of channels which make use of fixed carrier-, pilot- and test frequencies.

These frequencies can be set as preferred values in the TSA-2 when switched to FDM mode. They depend on the CCITT or INTELSAT plan which has been set.

TSA-2	Channels	Frequency range	Hierarchies/CCITT
CCITT#1	300	60...1300 kHz	5 SG/G.341
CCITT#2	300	64...1296 kHz	1 MG/G.341
CCITT#3	960	60...4028 kHz	16 SG/G.343, plan 1
CCITT#4	900	316...4188 kHz	3 MG/G.343, plan 2
CCITT#5	2700	312...12336 kHz	3 x 15 SG /G.332, plan 2
CCITT#6	2700	316...12388 kHz	3 SMG/G.332, plan 1A
CCITT#7	10800	4332...59684 kHz	12 SMG/G.333, plan 1
CCITT#8	10800	4404...59580 kHz	12 x 15 SG/G.333, plan 2
INTELSAT : Plans for 12, 24, ... , 1872 channels			

15 SG = 15 supergroup assembly = SMG (B)

Table 5-1

POSSIBLE FDM MEASUREMENTS

MODE	Parameters			Remarks
Carrier leak	Frequency	Level	Jitter	
Pilot	Frequency	Level	Jitter	
Tone	Frequency	Level	Jitter	
Power		Level		Unweighted
Noise		Level		Weighted

.....use TSA-2 SELECTIVE LEVEL mode

_ _ _ _use TSA-2 DEMODULATION mode

o o o o use TSA-2 PHASE JITTER mode

Table 5-2

Operating modes such as Spectrum- or network analysis, wideband level and tone search do not make use of preferred frequencies. The instrument will therefore switch back to Hz mode when you make measurements in these other modes.

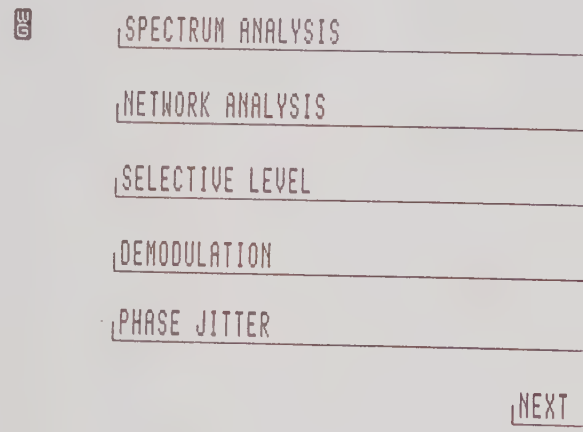
5.1 TSA-2 SELECTIVE LEVEL MODE

5.1.1 Select SELECTIVE LEVEL mode

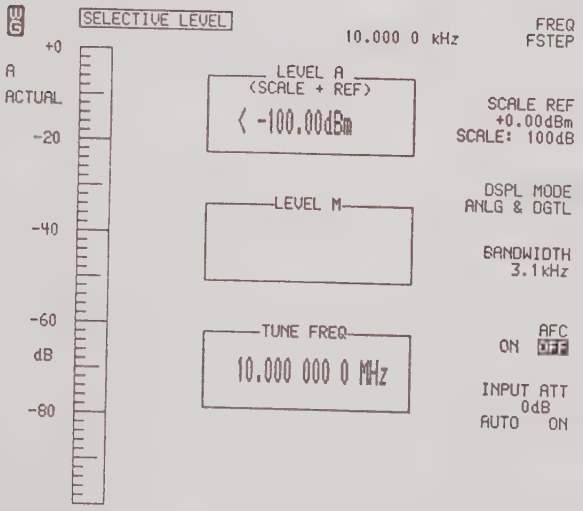
RCL 0-9

0

Press the key sequence [RCL 0-9] and [0] to set the TSA-2 to the standard setting

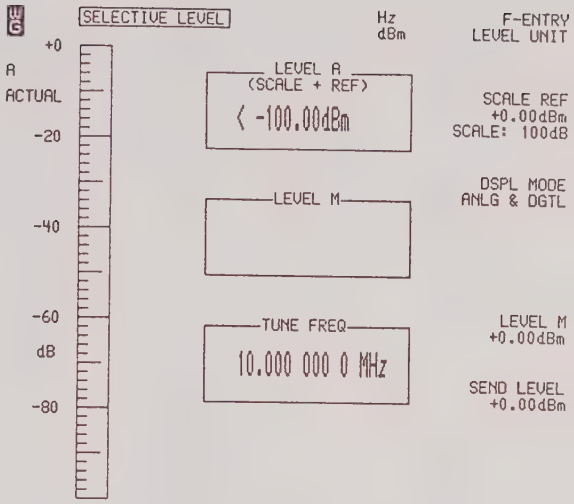


You'll see page 1 of the MODE MENU; set SELECTIVE LEVEL mode by pressing softkey 3

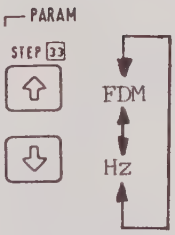


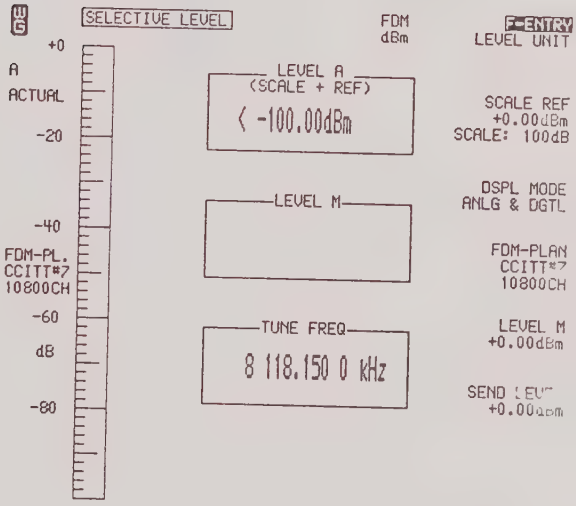
5.1.2 Switch to FDM measurements

press [DSPLY PARAM] key;
softkey 1 is now labelled
F-ENTRY Hz
LEVEL UNIT dBm



Press softkey 1 until F-ENTRY
is shown in reverse field

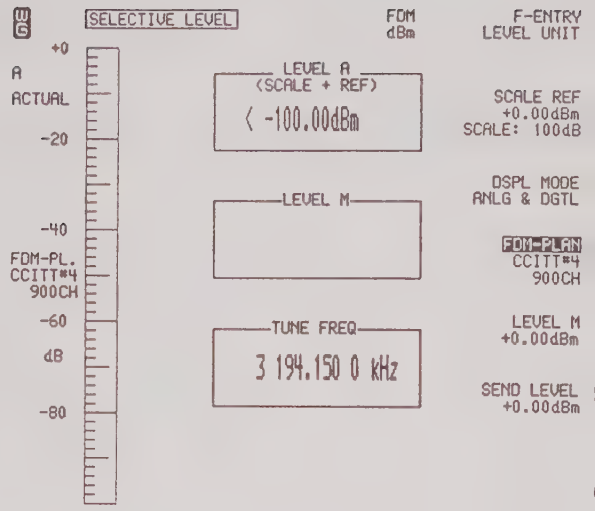




Use the STEP keys to switch
F-ENTRY to FDM
Softkey 4 will then be labelled
with the current FDM-plan (CCITT#7).
This is also displayed next to the bar
scale on the left hand side of the
screen

5.1.3 Select FDM-PLAN

Press Softkey 4 until FDM-PLAN is shown in reverse field.
Use the STEP-keys to select the required FDM plan



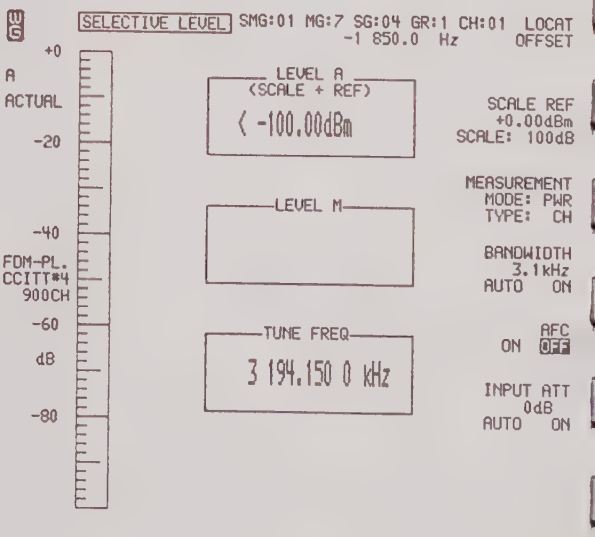
increase
decrease

INTELS.
CCITT#8
CCITT#7
CCITT#6
CCITT#5
CCITT#4
CCITT#3
CCITT#2
CCITT#1

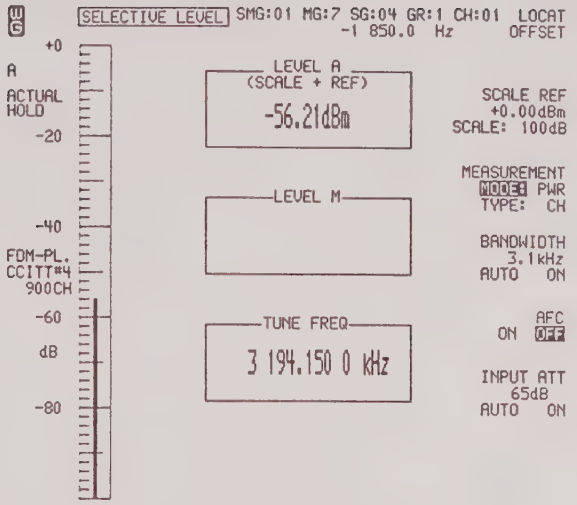
The parameter which you have selected is incremented or decremented each time you press the key.

5.1.4 Select MEASUREMENT MODE

Press [DSPLY PARAM] key



Press Softkey 3 until MODE
is shown in reverse field



TNE
PWR
PLT
CAR

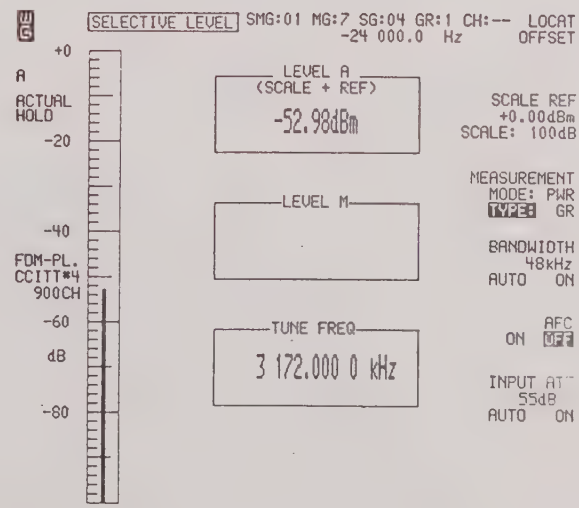
Use the STEP keys to select

POSSIBLE MEASUREMENT MODES					
Measurement MODE	SMG	MG	SG	GR	CH
Carrier leak	X	X	X	X	X
Pilot	X	X	X	X	
Tone					X
Power (unweighted)				X	X

Table 5-3

5.1.5 Select MEASUREMENT TYPE

Press Softkey 3 until TYPE
is shown in reverse field



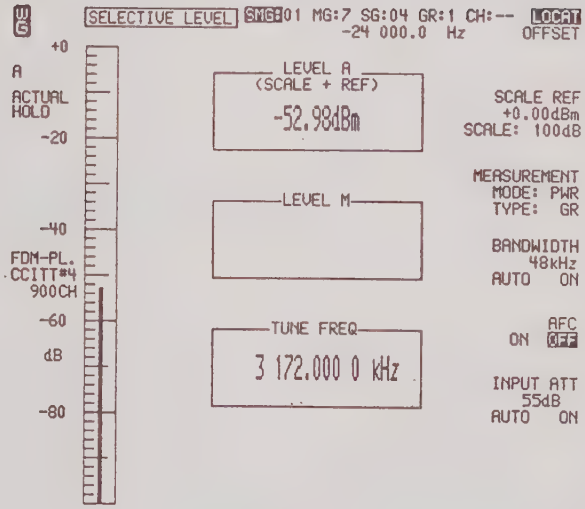
SMG
MG
SG
GR
CH

Use the STEP keys to select
(see also table 5-3)

Note parameter LOCATION (softkey 1)

5.1.6 Select LOCATION

Press softkey 1 to select
the location of the TYPE
you want to measure



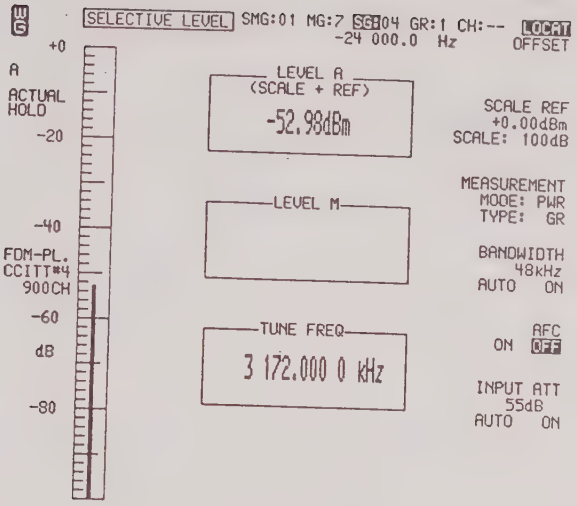
Use the point key to select
the group or channel

NOTE: The sign behind a group or channel can be:

** = this group is not available in this FDM-PLAN

-- = this group or channel is not current for the measurement TYPE

Enter the code for selected group or channel



using either the STEP keys

PARAM

STEP ↕

increase

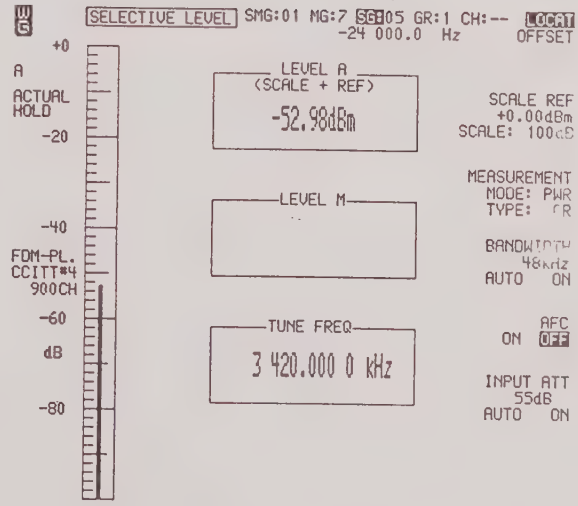
decrease

The parameter which you have selected is incremented or decremented each time you press the key.

or the numeric keypad

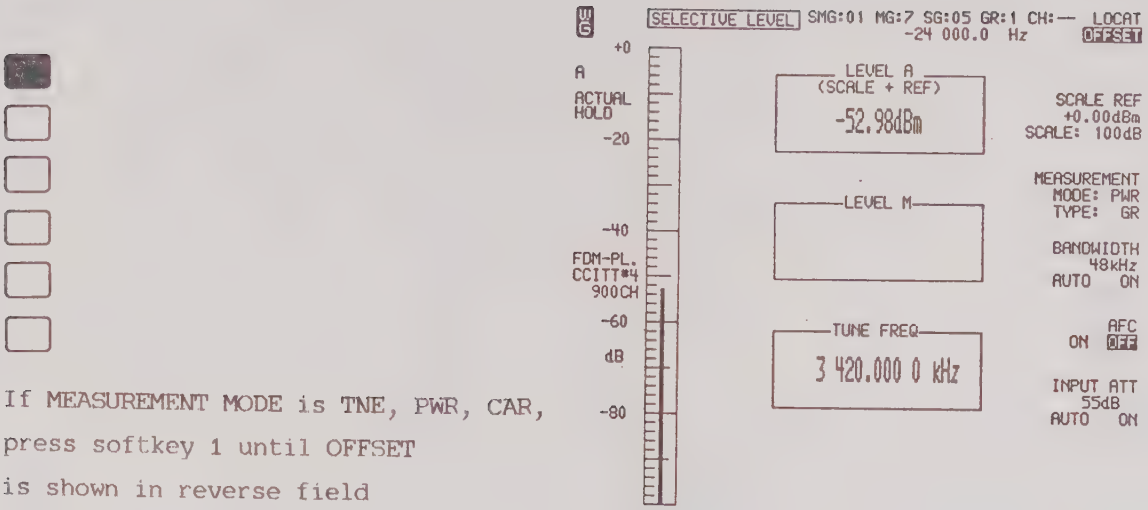
The values must be entered in the following manner:

Eingabe/DATA ENTRY ↕



* Enter the numerical value of the parameter using the numerical keypad
  - If you make a mistake erase the entry with /CLR/
* Terminate entry with appropriate unit /MHz/ or /kHz/ or /Hz dB/ (ENTER function).

5.1.7 Display or change OFFSET



If MEASUREMENT MODE is TNE, PWR, CAR, press softkey 1 until OFFSET is shown in reverse field

Preferred frequencies, displayed for the OFFSET parameter

TYPE / MODE	Preferred frequencies/Hz				
	CH	GR	SG	MG	SMG
TNE	800 1) 1020 1850	–	–	–	–
PWR	-1850 1850	-24000 24000	–	– 2)	–
CAR	0	0	0	0	0

Table 5-4

1) STEP ⇧ / ⇩ If there are more preferred frequencies, you can select them using the STEP keys

2) In POWER mode, you can see an erect sideband (pos. mid-band OFFSET frequency) or an inverted sideband (neg. mid-band OFFSET frequency)

* You can change the OFFSET frequency by

- setting the frequency by "MANUAL TUNING"

* Press /MANUAL TUNING/ [36] (on/off function), LED comes on

* ◯ [40]

- turn clockwise: frequency increases
- turn anticlockwise: frequency decreases

- or using the numeric keypad

The values must be entered in the following manner:

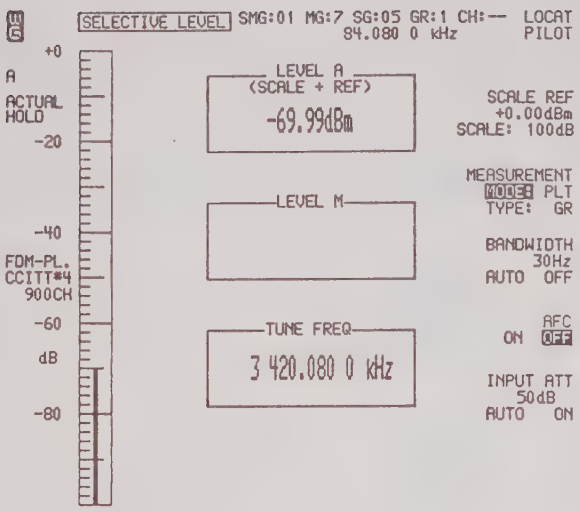
* Enter the numerical value of the parameter using the numerical keypad
  - If you make a mistake erase the entry with /CLR/
* Terminate entry with appropriate unit /MHz/ or /kHz/ or /Hz dB/ (ENTER function).

* RESET the OFFSET frequency

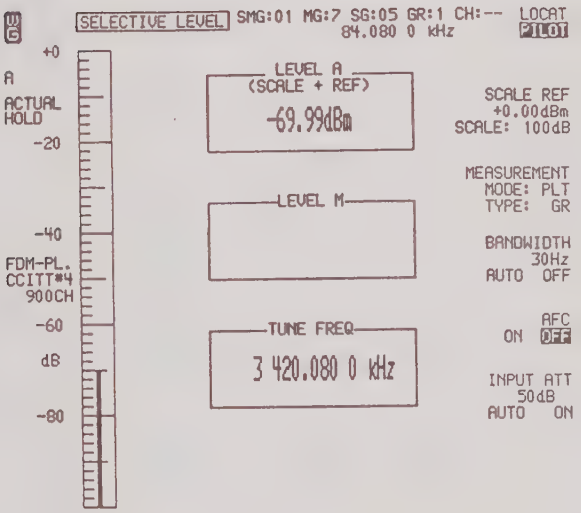
You can RESET the OFFSET frequency to the last preferred frequency selected

5.1.8 Display PILOT

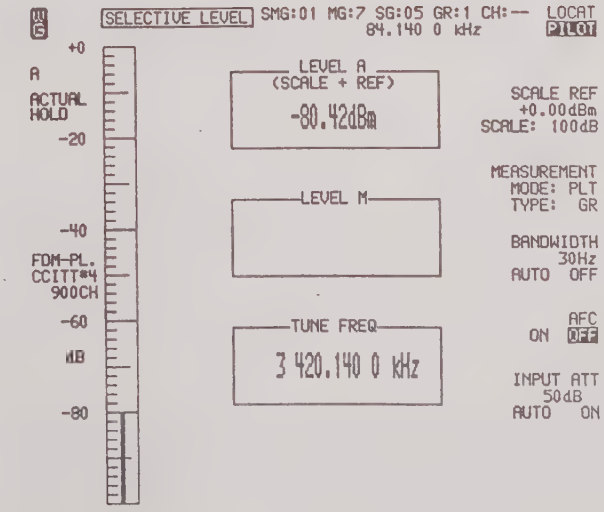
If MEASUREMENT MODE: PLT is selected, the actual pilot frequency is shown beside softkey 1 PILOT



Press Softkey 1 until PILOT is shown in reverse field

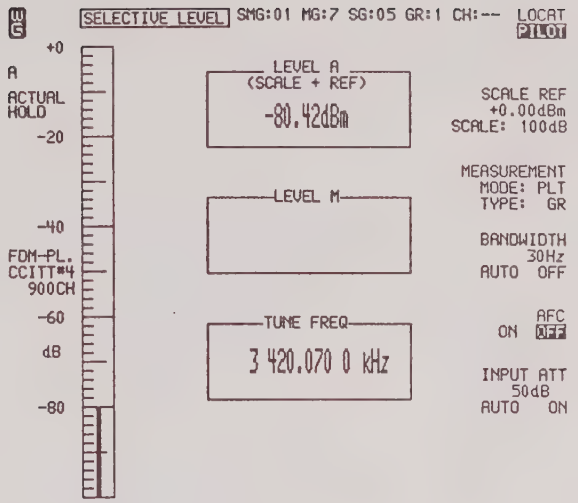


If there are more pilot frequencies, you can select them using the STEP keys



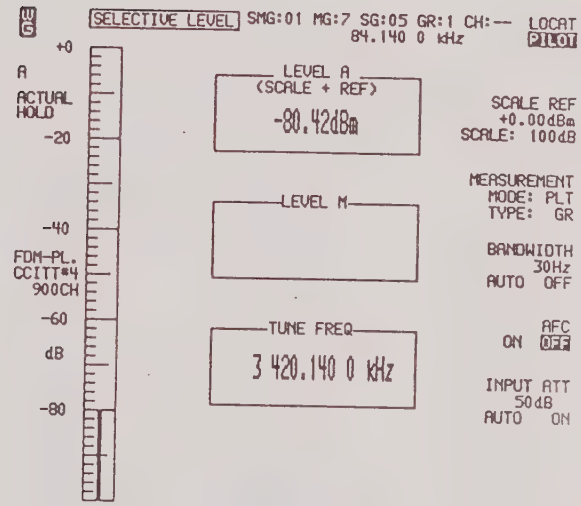
If you change "TUNE FREQUENCY",

the pilot frequency will be erased



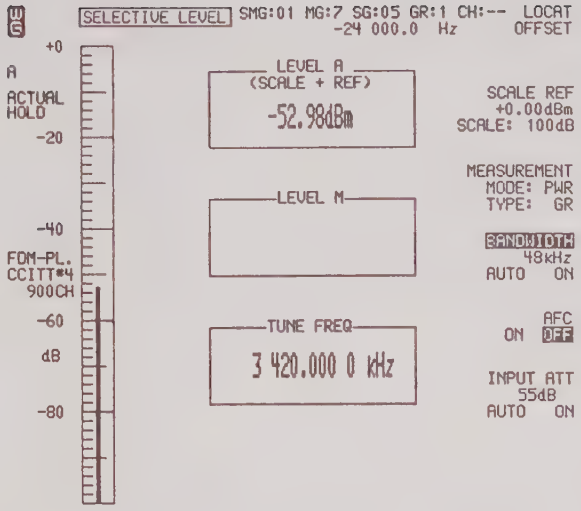
AUTO

You can RESET the PILOT frequency to the last preferred frequency selected



5.1.9 Select BANDWIDTH

Press softkey 4 until BANDWIDTH is shown in reverse field



The bandwidth will be coupled to the MEASUREMENT (MODE and TYPE). It is selected automatically

MODE		TYPE	BANDWIDTH
CAR	CARRIER	-	30 Hz
PLT	PILOT	-	30 Hz
PWR	POWER	CH	3.1 kHz
PWR	POWER	GR	48 kHz
TNE	TONE	CH	30 Hz

Table 5-5

48 kHz
3.1 kHz
300 Hz
30 Hz
10 Hz

You can change the bandwidth with the STEP keys (AUTO OFF)

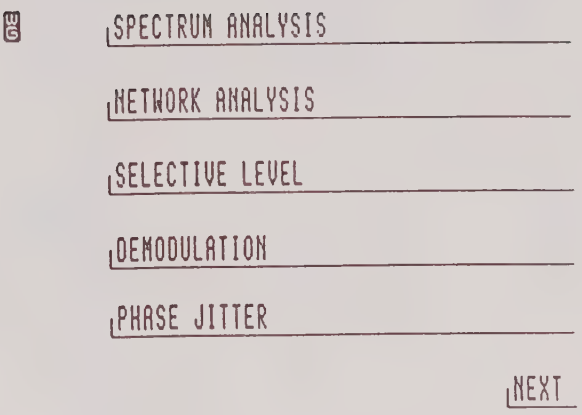
5.2 TSA-2 DEMODULATION MODE

5.2.1 Select DEMODULATION mode

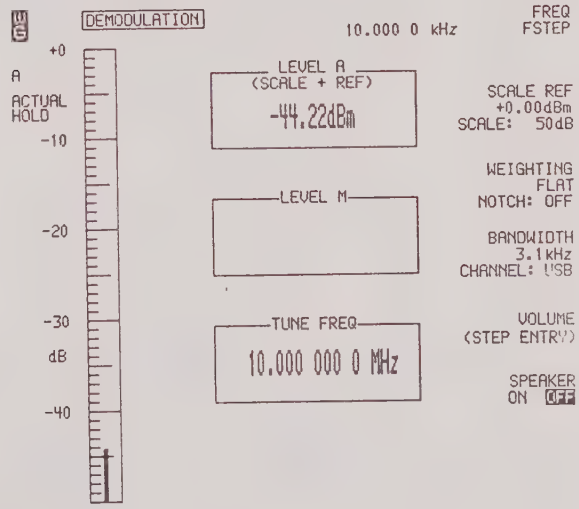
RCL 0-9

0

Press the key sequence [RCL 0-9] and [0] to set the TSA-2 to the standard setting

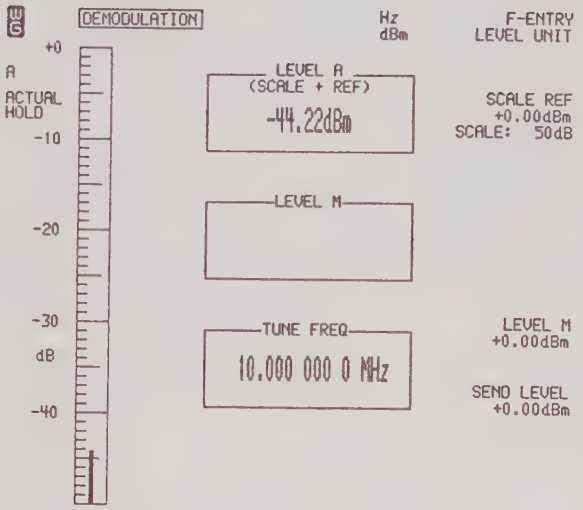


Now you see page 1 of the MODE MENU set DEMODULATION mode by pressing softkey 4

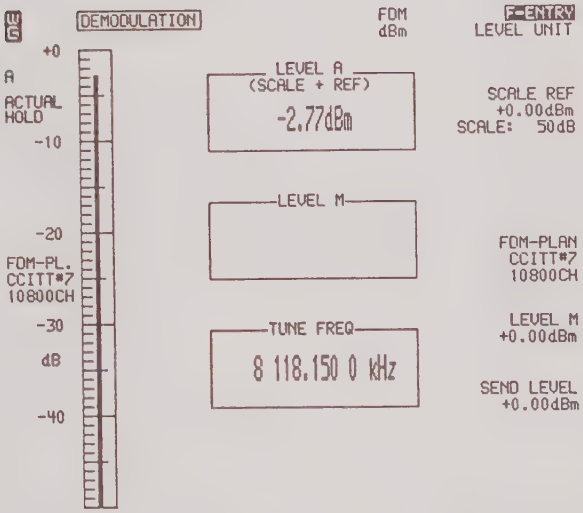


5.1.2 Switch to FDM measurements

press [DSPLY PARAM] key;
softkey 1 is now labelled
F-ENTRY Hz
LEVEL UNIT dBm



Press softkey 1 until F-ENTRY
is shown in reverse field

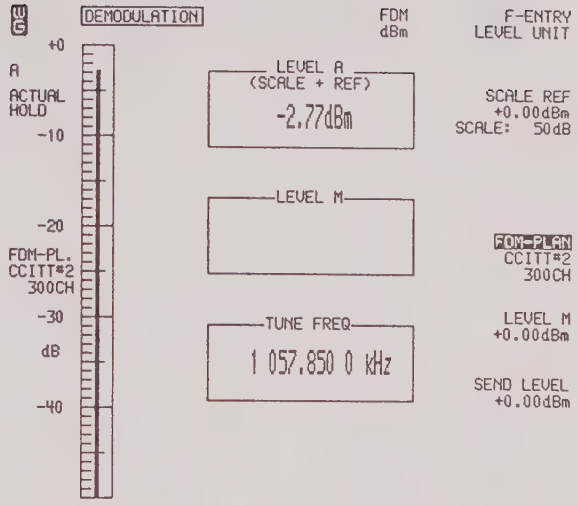


Use the STEP keys to switch
F-ENTRY to FDM

Softkey 4 will then be labelled
with the current FDM-plan (CCITT#7).
This is also displayed next to the bar
scale on the left hand side of the
screen

5.1.3 Select FDM PLAN

Press Softkey 4 until FDM-PLAN is shown in reverse field.
Use the STEP keys to select the required FDM plan



PARAM
STEP 33

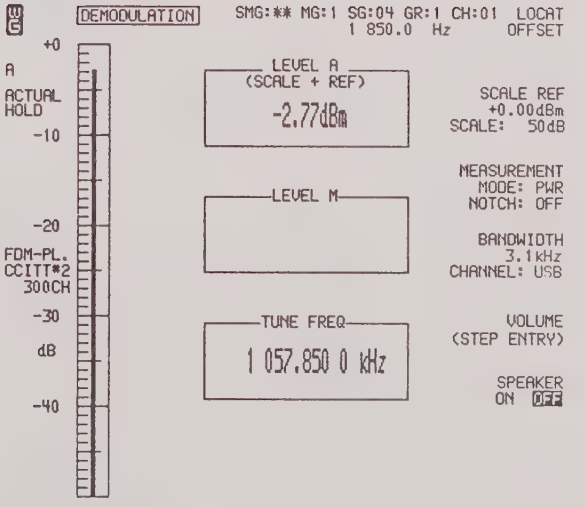
increase
decrease

INTELS.
CCITT#8
CCITT#7
CCITT#6
CCITT#5
CCITT#4
CCITT#3
CCITT#2
CCITT#1

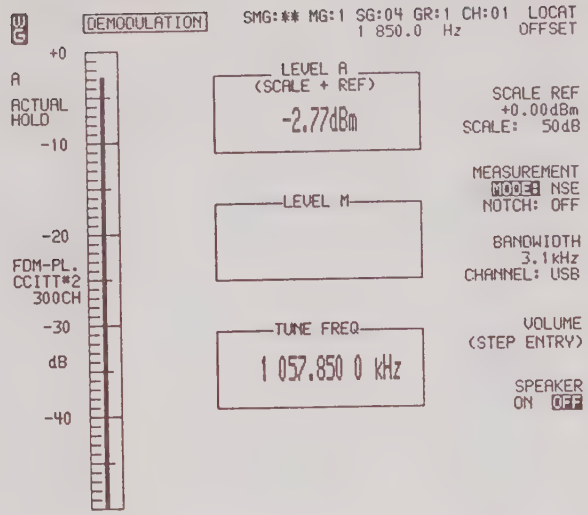
5.1.4 Select MEASUREMENT MODE

Press [DSPLY PARAM] key

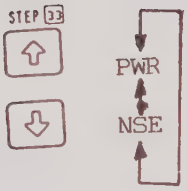
DSPLY PARAM



Press Softkey 3 until MODE is shown in reverse field



Use the STEP keys to select

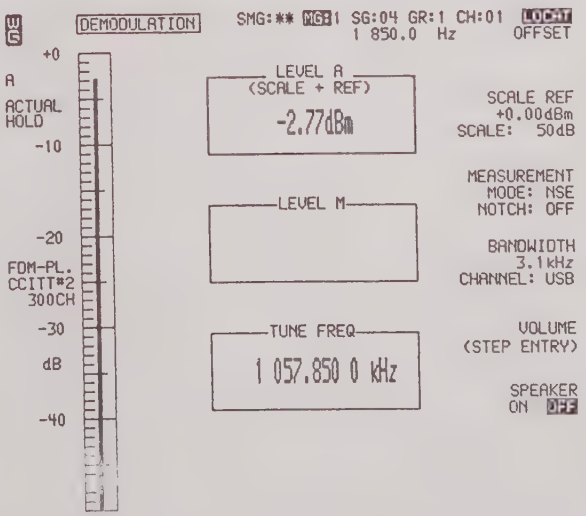


POSSIBLE MEASUREMENT MODES					
Measurement MODE	SMG	MG	SG	GR	CH
Power (unweighted)	—	—	—	—	X
Noise (weighted)	—	—	—	—	X

Table 5-6

5.2.5 Select LOCATION

Press softkey 1 to select the location of the channel you want to measure



Use the point key to select the group or channel

NOTE: The sign behind a group or channel can be:

** = this group is not available in this FDM-PLAN

Enter the code for selected group or channel

using either the STEP keys

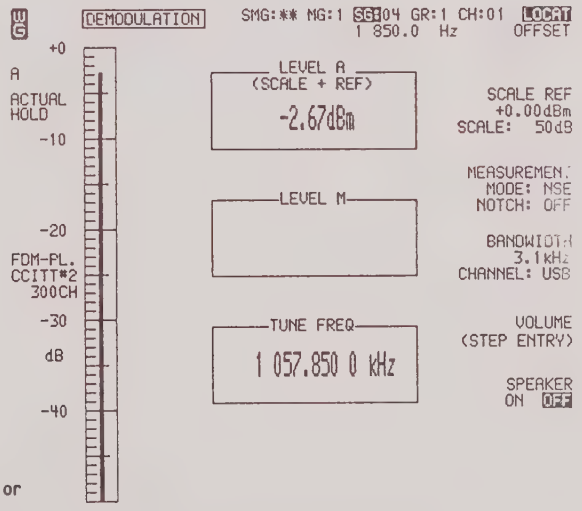
PARAM

STEP 33

increase

decrease

The parameter which you have selected is incremented or decremented each time you press the key.



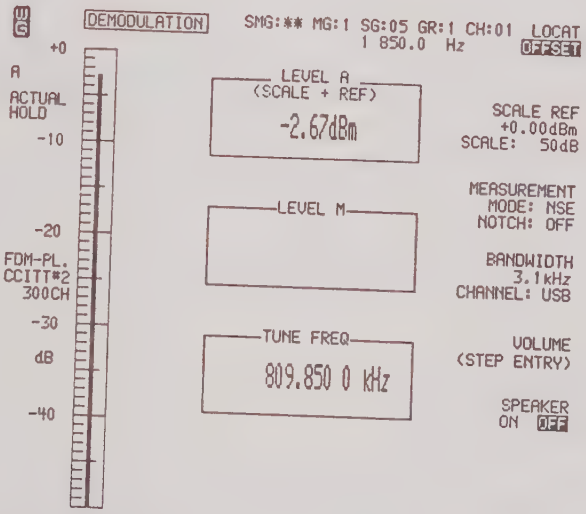
or the numeric keypad

The values must be entered in the following mannen:

* **Enter the numerical value of the parameter using the numerical keypad**
  - **If you make a mistake erase the entry with /CLR/**
* **Terminate entry with appropriate unit /MHz/ or /kHz/ or /Hz dB/ (ENTER function).**

5.2.6 Display or change OFFSET

press softkey 1 until OFFSET is shown in reverse field



The preferred frequency for the OFFSET parameter is 1850 Hz (the center of the VF-band).

The sideband is always demodulated as erect sideband. You can see if it is the upper sideband (pos. mid-band OFFSET frequency) or the lower sideband (neg. mid-band OFFSET frequency). Softkey 4 is corresponding: CHANNEL USB or LSB

* You can change the OFFSET frequency by

- setting the frequency, turning the knob "MANUAL TUNING" or

* Press /MANUAL TUNING/ [36] (on/off function), LED comes on

* [40]
  - turn clockwise: frequency increases
  - turn anticlockwise: frequency decreases

- using the numeric keypad

The values must be entered in the following manner:

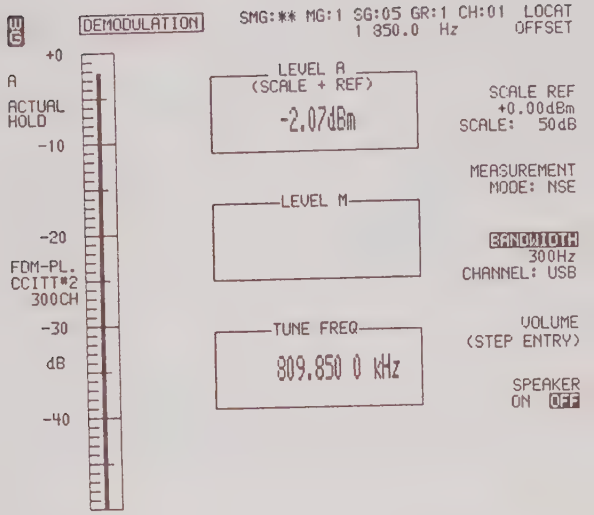
* Enter the numerical value of the parameter using the numerical keypad
  - If you make a mistake erase the entry with /CLR/
* Terminate entry with appropriate unit /MHz/ or /kHz/ or /Hz dB/ (ENTER function).

* RESET the OFFSET frequency

You can RESET the OFFSET frequency to the preferred frequency

5.2.7 Select BANDWIDTH

Press softkey 4 until BANDWIDTH is shown in reverse field



The bandwidth is set now: 3.1 kHz. You can measure noise or power of the selected channel.

MODE			BANDWIDTH
NSE	POWER	weighted	3.1 kHz psophometric CCITT P.53
PWR	POWER	unweighted	3.1 kHz

Table 5-7

You can change the bandwidth with the STEP keys

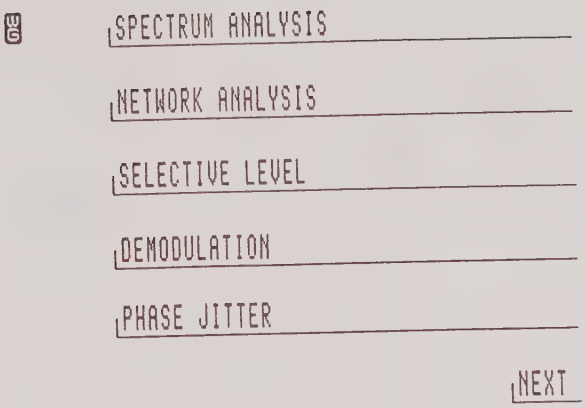
3.1 kHz
300 Hz
30 Hz
10 Hz

NOTE: In measurement NSE MODE, the test signal always passes through the psophometric weighting filter

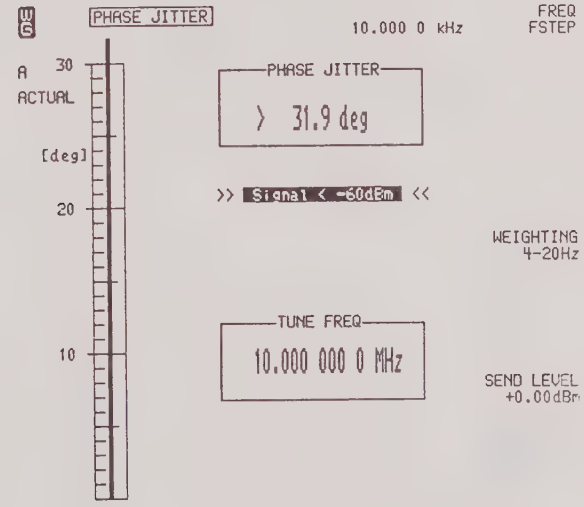
5.3 TSA-2 PHASE JITTER MODE

5.3.1 Select PHASE JITTER mode

Press the key sequence [RCL 0-9] and [0] to set the TSA-2 to the standard setting

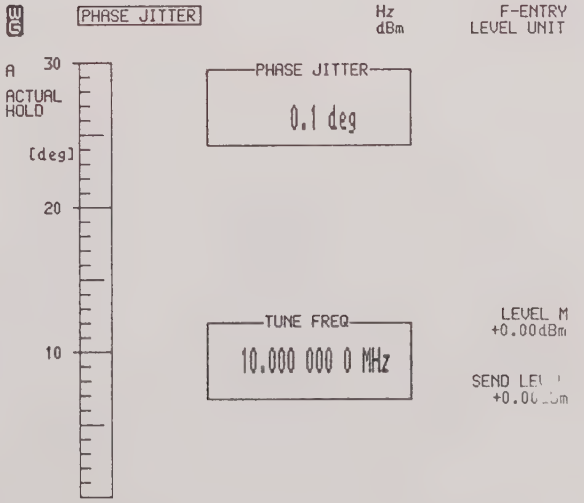


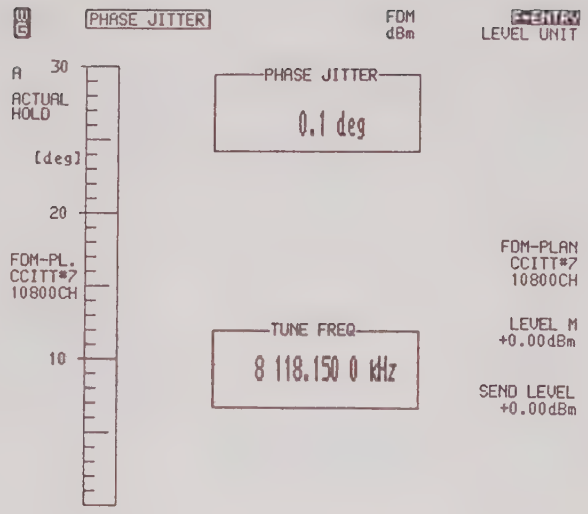
Now you see page 1 of the MODE MENU
set PHASE JITTER mode by
pressing softkey 5



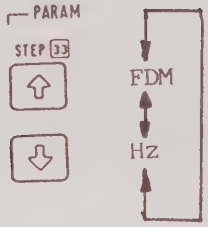
5.3.2 Switch to FDM measurements

press [DSPLY PARAM] key;
softkey 1 is now labelled
F-ENTRY Hz
LEVEL UNIT dBm





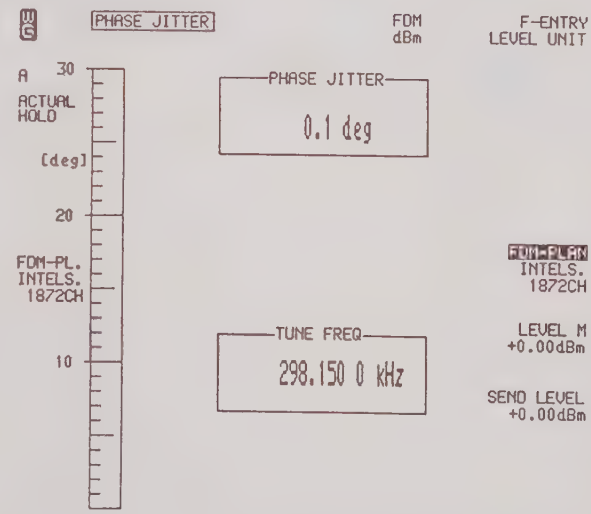
Press softkey 1 until F-ENTRY is shown in reverse field



Use the STEP keys to switch F-ENTRY to FDM

Softkey 4 will then be labelled with the current FDM-plan (CCITT#7). This is also displayed next to the bar scale on the left hand side of the screen

5.3.3 Select FDM PLAN



Press Softkey 4 until FDM-PLAN is shown in reverse field.
Use the STEP keys to select the required FDM plan

increase

decrease

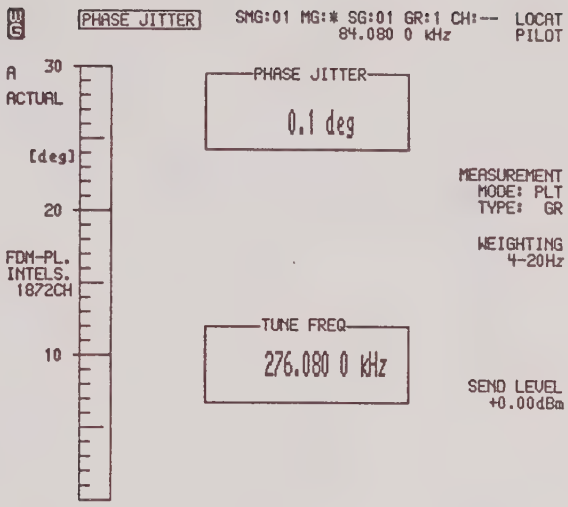
INTELS.
CCITT#8
CCITT#7
CCITT#6
CCITT#5
CCITT#4
CCITT#3
CCITT#2
CCITT#1

The parameter which you have selected is incremented or decremented each time you press the key.

5.3.4 Select MEASUREMENT MODE

DSPLY PARAM

Press [DSPLY PARAM] key



Press Softkey 3 until MODE is shown in reverse field

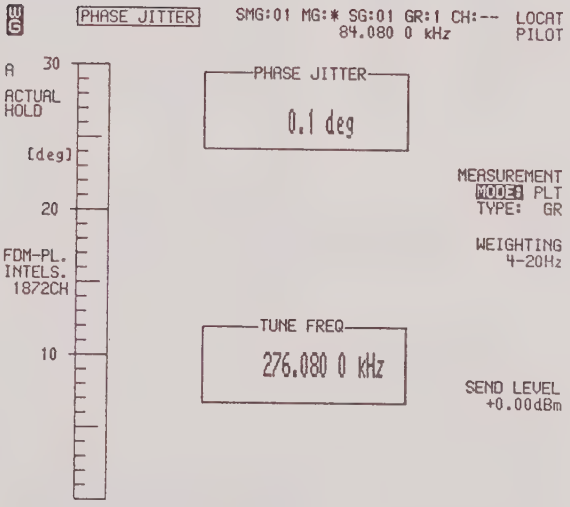
PARAM

STEP

TNE

PLT

CAR



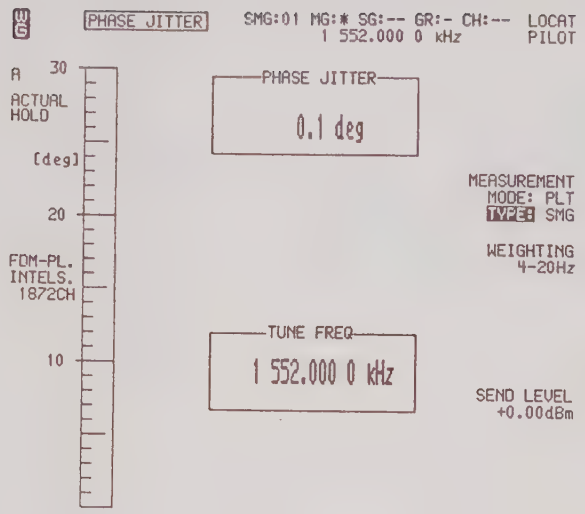
Use the STEP keys to select

POSSIBLE MEASUREMENT MODES						
Measurement MODE		SMG	MG	SG	GR	CH
Channel tone	TNE					X
Group pilot	PLT	X	X	X	X	
Carrier leak	CAR	X	X	X	X	X

Table 5-8

5.3.5 Select MEASUREMENT TYPE

Press Softkey 3 until TYPE
is shown in reverse field



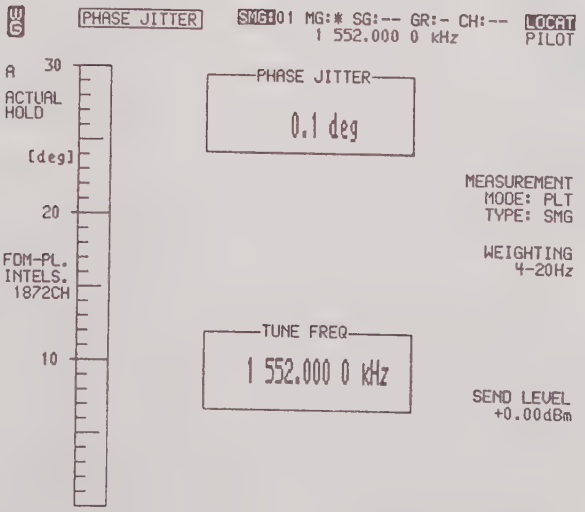
SMG
MG
SG
GR
CH

Use the STEP keys to select
(see also table 5-8)

Note parameter LOCATION (softkey 1)

5.3.6 Select LOCATION

Press softkey 1 to select
the location of the TYPE
frequency you want to measure



Use the point key to select the group or channel

NOTE: The sign behind a group or channel can be:

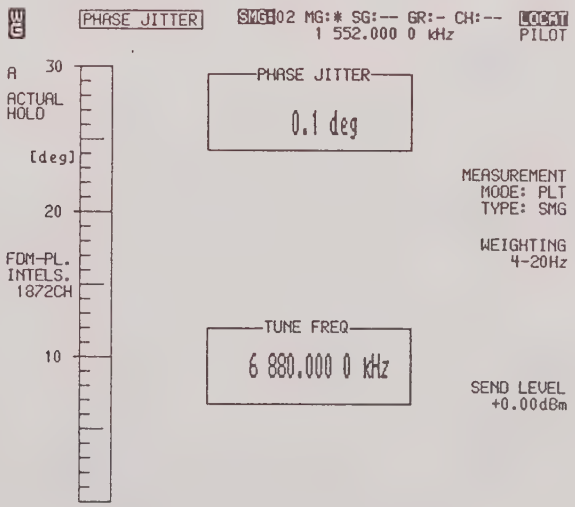
** = this group is not available in this FDM-PLAN

-- = this group or channel is not current for the measurement TYPE

Enter the code for selected group or channel

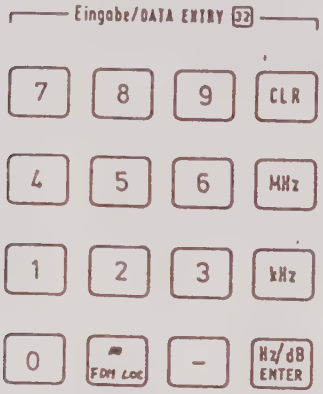
using either the STEP keys

The parameter which you have selected is incremented or decremented each time you press the key.



or the numeric keypad

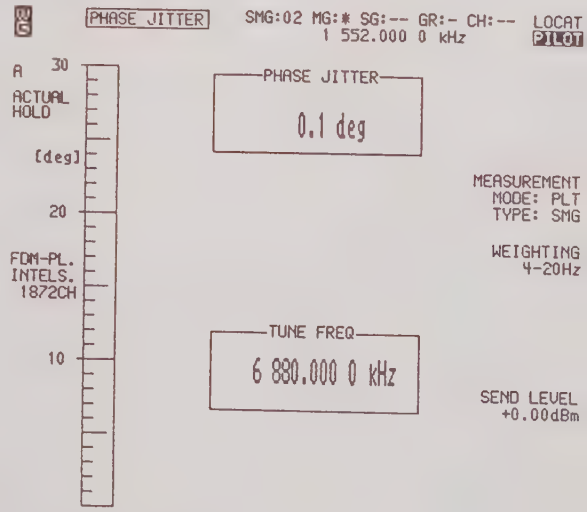
The values must be entered in the following manner:



* Enter the numerical value of the parameter using the numerical keypad
  - If you make a mistake erase the entry with /CLR/
* Terminate entry with appropriate unit /MHz/ or /kHz/ or /Hz dB/ (ENTER function).

5.3.7 Display PILOT

If MEASUREMENT MODE: PLT is selected, the actual pilot frequency is shown beside softkey 1, PILOT

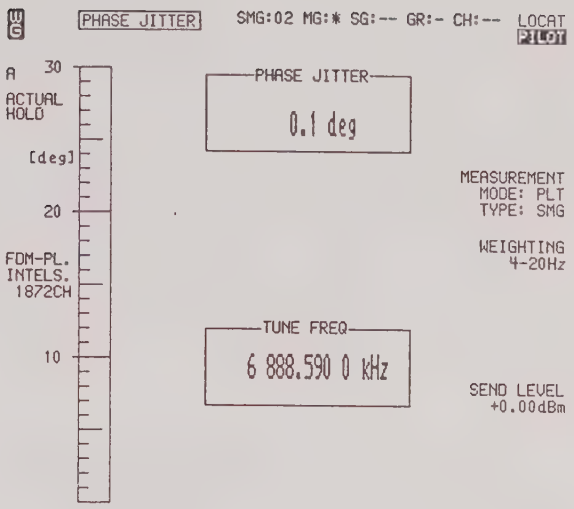


Press Softkey 1 until PILOT is shown in reverse field

If there are more pilot frequencies, you can select them using the STEP keys

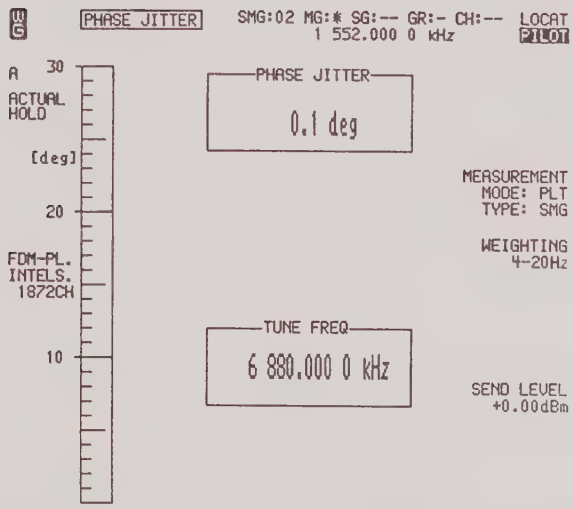
If you change "TUNE FREQUENCY",

the pilot frequency will be erased



AUTO

You can RESET the PILOT and tune frequency to the last preferred frequency selected



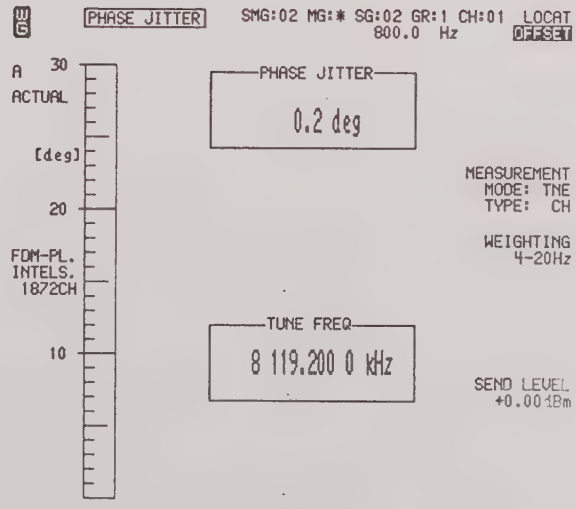
5.3.8 Display or change OFFSET

If MEASUREMENT MODE is TNE or CAR,

the actual offset frequency

is shown beside softkey 1, OFFSET

press softkey 1 until OFFSET is shown in reverse field



Preferred frequencies, displayed for the OFFSET parameter

TYPE / MODE	Preferred frequencies/Hz				
	CH	GR	SG	MG	SMG
TNE	800 1) 1020 1850	–	–	–	–
PLT	pilot frequencies 1)				
CAR	0	0	0	0	0

Table 5-9

1) STEP [33] If there are more preferred frequencies, you can select them using the STEP keys

* You can change the OFFSET frequency by

– setting the frequency, turning the knob "MANUAL TUNING" or

* Press /MANUAL TUNING/ [36] (on/off function), LED comes on

* [40]
- turn clockwise: frequency increases
- turn anticlockwise: frequency decreases

– using the numeric keypad

* Enter the numerical value of the parameter using the numerical keypad
- If you make a mistake erase the entry with /CLR/

* Terminate entry with appropriate unit /MHz/ or /kHz/ or /Hz dB/ (ENTER function).

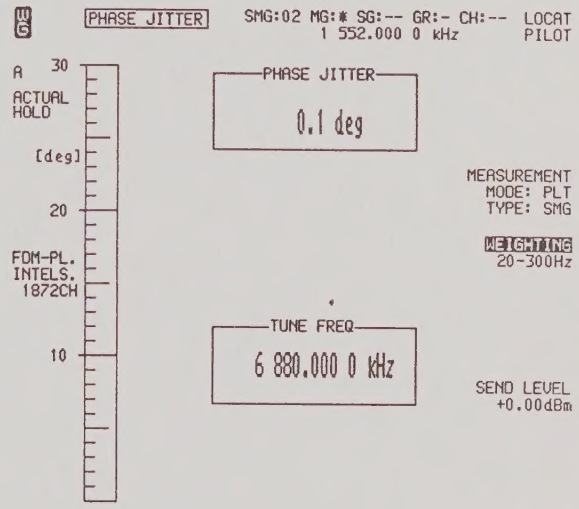
* RESET the OFFSET frequency

AUTO

You can RESET the OFFSET frequency to the preferred frequency

5.3.9 Select WEIGHTING

Press softkey 4 until WEIGHTING is shown in reverse field



The demodulated phase jitter is weighted by filters, specified in CCITT Rec. O 91

You can change the WEIGHTING filter with the STEP keys

STEP

⇧	4-300 Hz
	20-300 Hz
⇩	4-20 Hz